# Hydraulics & Pneumatics

NOVEMBER 1960

EDITORIAL DEPT
UNIVERSITY MICROFILMS INC
313 NORTH FIRST ST
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## How to select quick-connect couplings

see contents page 3

THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

*Also in this issue:*

- *Protecting Air Lubricator and Filter Bowls*
- *Electrohydraulic Servovalves in Industry*
- *Use Oil to Synchronize Air Cylinders*

# HANSEN

SERIES HK QUICK-CONNECTIVE

TWO-WAY SHUT-OFF

COUPLINGS

*As easy as plugging in your electric shaver...*

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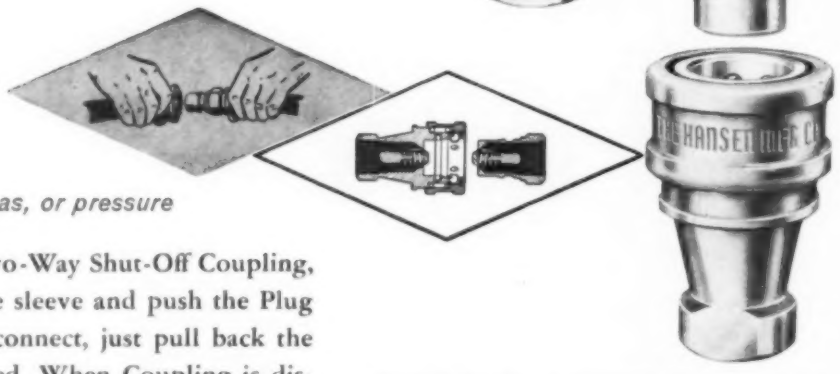
*with instant automatic flow*



## QUICK DISCONNECTION

*with instant automatic shut-off*

*...prevents loss of liquid, gas, or pressure*

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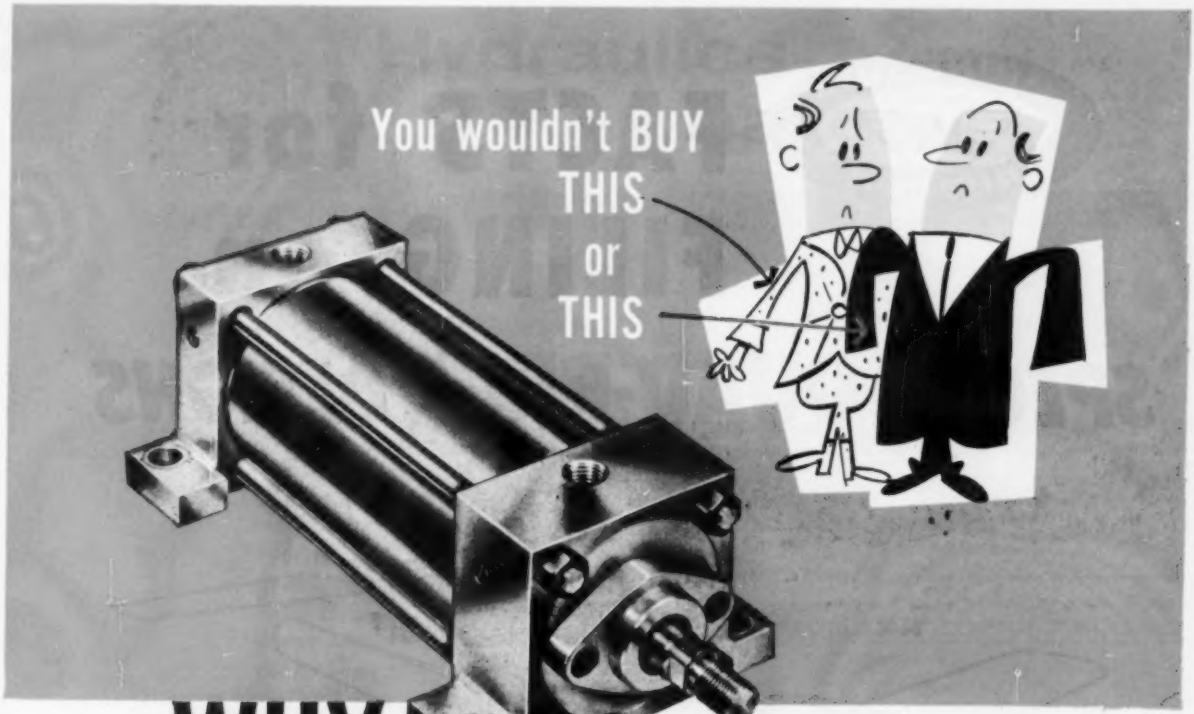


# WHY SETTLE for a Cylinder

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**Hanna cylinders are as economically priced as most "stock" cylinders and are a far better value in the long run.**

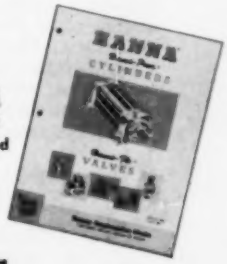
**Hanna can deliver several cylinders as promptly as one or two because we are not limited to a fixed stock.**

**With Hanna Service emphasis is placed on "When do you need it?" You'll find we can ship according to your schedule.**

For top quality, custom built cylinders at prices and deliveries competitive to less suitable "stock" cylinders, call us or your nearby Hanna Representative. He is listed in the Yellow Pages under "Cylinders" and in Thomas' Directory.

WRITE FOR NEW CATALOG #1000-A

**It will give you details on Hanna-Powr Cylinders and Hanna-Flo Valves.**

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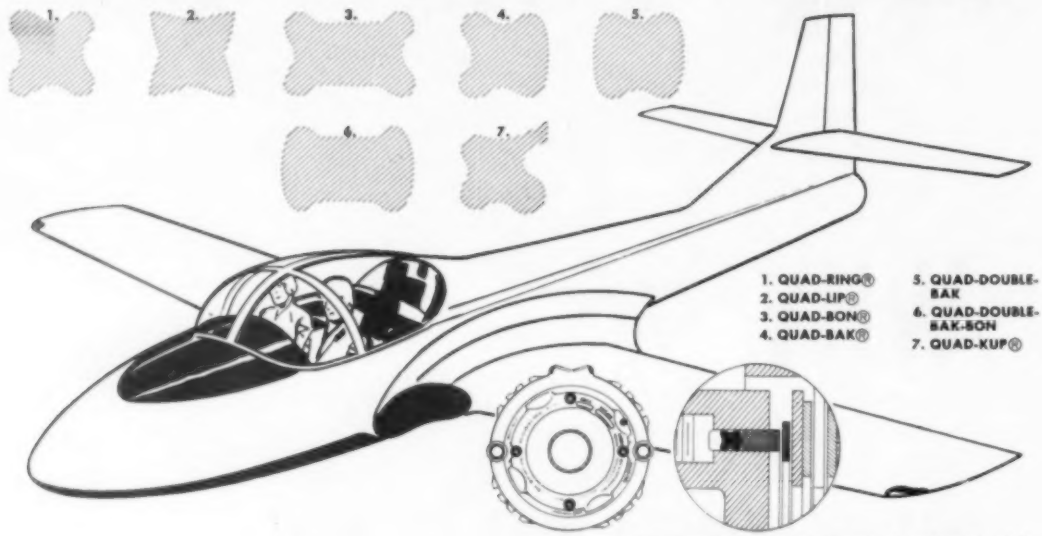
# SPECIAL QUAD-RING® DESIGNS




Quad-Bak—used as a power-transmitting dynamic seal installed on the Auto Specialties Manufacturing Co. aircraft brake.

## QUAD-RING® BASIS FOR THE DESIGN OF A WHOLE FAMILY OF VERSATILE SEALS

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QUAD-LIP—Developed for applications which require zero leakage at very low pressure differentials with minimum mechanical interference.

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QUAD-BAK—Designed to eliminate damage to packing when subjected to extreme extrusion in one direction only.

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These special cross sections of the basic QUAD-RING design are just a few of the modifications possible to give complete versatility for any sealing application.

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FOR MORE INFORMATION ON QUAD-RINGS AND A COPY OF THE MINNESOTA RUBBER FACT BOOK ... **WRITE**

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# Hydraulics & Pneumatics

VOLUME 13/NUMBER 11

NOVEMBER 1960

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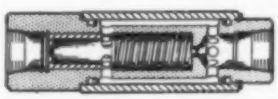

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THE MAGAZINE OF FLUID POWER

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# USEFUL LITERATURE

### COMPREHENSIVE NO. 403 CATALOG SHOWS ANCHOR "O" RING FLANGED HEAD HYDRAULIC HOSE ASSEMBLIES, CLAMP TYPE COUPLINGS, HOSE and WELD FITTINGS

Fluid power equipment users will find this all new Anchor Catalog No. 403 most helpful in finding the "right" Anchor "O" Ring Flanged Head Hydraulic Hose Assemblies, Clamp Type Couplings, Hose and Weld Fittings for particular hydraulic applications.

The new Anchor catalog graphically illustrates and describes Anchor's full range line of "O" Ring Flanged Head Pressed-On Couplings for such Anchor hose as 4 and 6 Ply Super Spiral Wire, Three Heavy Wire Braid, Two Wire and Two Heavy Wire Braid, One Wire Braid, and Spiral Wire Suction Return.

Anchor Clamp Type Couplings for Three Heavy Wire, Two Wire, Two Heavy Wire, One Wire, Hi-Burst Two Rayon, standard Two Rayon and Suction Return Spiral Wire Hose are also described.

Specifications and valuable data on Anchor Weld Fittings for new flexibility and versatility in use of pipe and tubing in hydraulic transmission lines cover Elbow Weld, "O" Ring Flanged Head Weld, Saddle Weld, Socket Weld, Split-Flange Halves and Components, Tank-Pilot Weld, Tee Weld, Weld Pipe Plugs, etc.

Of special interest are the newest, up-to-date SAE dimensions for Industrial Hydraulic Flanged Tube, Pipe and Hose Connections—Four Bolt Split-Flange Type, and Port Dimensions for Bolted Flange connections. An Anchor *"first"*, the designs for these Anchor products have set the standard for the industry.

Anchor's FLANCO "O" Ring Flanged Head Couplings used with Anchor's patented Split-Flange Clamp, providing a low cost, streamlined, reusable, convenient no-thread, no leak "O" Ring connection are pictorially described, together with their application use.

Detailed comprehensive data and cross-section views with all dimensions for all Anchor "O" Ring Flanged Head Hydraulic Hose Assemblies, Clamp Type Couplings, Hose and Weld Fittings are included, together with valuable technical and engineering data to assist fluid power equipment users in ordering these Anchor products . . . *"first"* for years in original equipment.

Copies of the new Anchor Catalog No. 403, a practical working tool for specifying and ordering Anchor top-quality, performance-proven "O" Ring Flanged Head Hydraulic Hose Assemblies, Split-Flanges, Clamp Type Couplings, Hose and Weld Fittings will be sent, on letterhead request, by writing Anchor Coupling Co., Inc. 372 North Fourth St., Libertyville, Ill.

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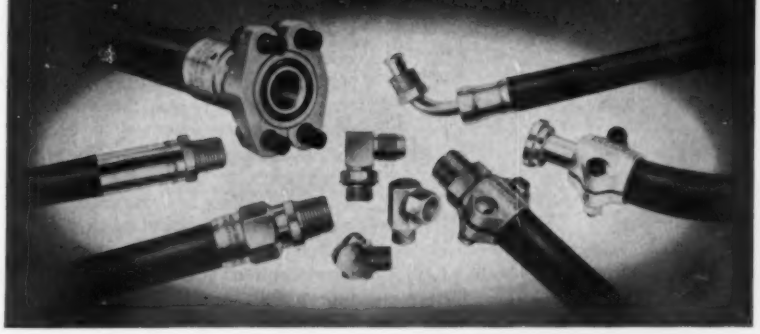
ANCHOR®...THE PLEDGE OF PERFORMANCE

## IN HYDRAULIC TRANSMISSION LINES

Failure in a fluid power transmission line is usually costly, with expensive equipment down, production delays and idle manpower until repairs can be made.

To hold such breakdowns to a minimum, Anchor has not only established rigid quality standards to which all Anchor Hydraulic Hose Assemblies must conform, but makes frequent tests and inspections of materials and workmanship to ensure conformity to these high standards.

Because of this, the Anchor emblem on any piece of hydraulic equipment is a real "pledge of performance" and service.



**Andy Anchor says:**

"My condensed Bulletin briefly describes the complete Anchor line. Send for it now!"

ANCHOR HOSE ASSEMBLIES with ANCHOR Pressed-On Couplings are available for high, medium and low pressure service with maximum working pressures ranging from 12,500 PSI for 3/16" I.D. 6 Ply Super Spiral Hose to 100 PSI for 2" I.D. Spiral Wire Suction Hose.

ANCHOR REUSABLE COUPLINGS — Regular or Clamp Type, are available for emergency repair and year-to-year superior performance for high, medium and low pressure service ranging from 5000 PSI for 1/4" I.D. 2-Wire Braid Hose to 100 PSI for 2" I.D. Spiral Wire Suction Hose.

ANCHOR 4-BOLT SPLIT-FLANGE "O" RING HEAD COUPLINGS are available in a wide range of sizes for high, medium and lower pressure applications.

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ANCHOR COUPLING CO. INC.

371 North Fourth Street, Libertyville, Illinois

Branch Plants: Dallas, Tex., Plymouth, Mich.

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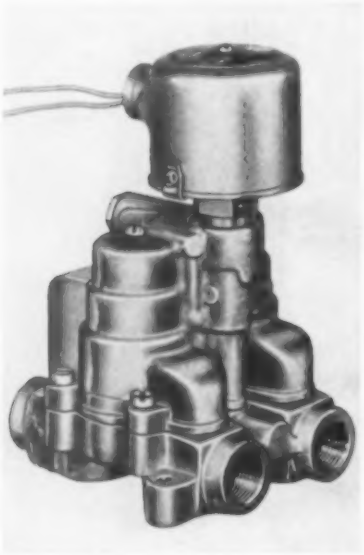
# Why Name an Air Valve "Mach 2"?

"Mach 2" is the name of a new Crescent® Air Valve now ready for distribution to industry. An identifying name is desirable for this valve to point up the new kind of performance it brings to air control and to distinguish it from the other valves in the long-established Crescent® line.



The new Crescent "Mach 2" 4-Way Valve. (Half-inch pipe size shown.)

### A Breakthrough in Cycling Speed

Actually these Crescent® "Mach 2" 3-Way and 4-Way Air Valves represent a breakthrough, as the name suggests. For years a cycling speed of 600 to 700 cycles a minute seemed to be the limit for solenoid pilot valves. The original Crescent 4-Way Valves attained that speed a long time before other valves even approached it. Now, the "Mach 2" has been tested and rated for 1000 cycles per minute continuous duty. During a two-hour test at a speed of over 1500 cycles per minute the coil temperature stabilized at 7°C below the maximum code limit for class A coils. Cycling speeds as high as 2100 have been successfully reached for intermittent periods of 20 minutes.

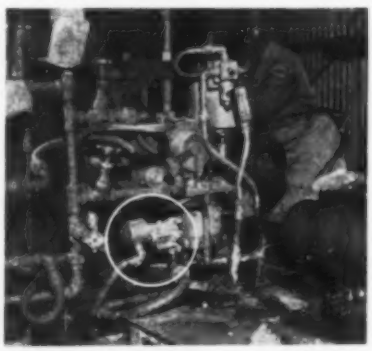
### Brings New Dependability

We realize that such high cycling speeds are seldom needed. However, speed and endurance seem to be Siamese twins. Here's why: (1) Speed depends on an extremely short stroke of the solenoid plunger (3/32 of an inch—approximately the thickness of a nickel—in the new "Mach 2"). This greatly reduces coil heating and, as heat goes down, coil life expectancy goes up. (2) High cycling speeds demand a drastic reduction of friction in the solenoid and pilot valve section. In the "Mach 2" pilot valve, a tiny ball seats on "O" rings at both ends of a pilot cartridge. The ball moves freely, independent of the seals. There is no "O" ring drag on the pilot plunger because it requires no seals; where there is no friction there can be no wear.

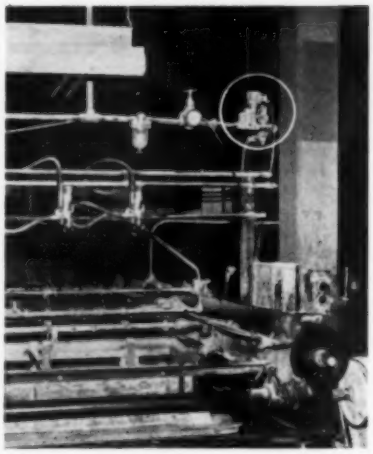
Similarly, the main valve seats seal on "O" rings. Metal shoulders take the shock in such a way that the "O" ring seal is merely kissed by the seat in the sealed position; since they are only minutely flexed they don't fatigue or lose their resilience.

### 100 Million Cycle Guarantee

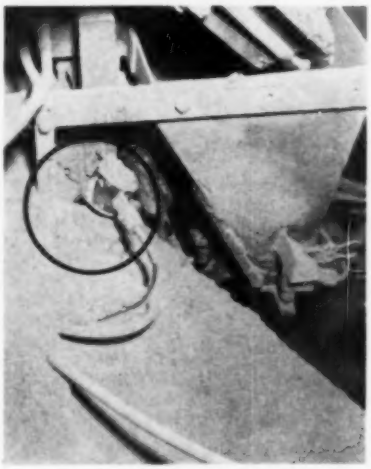
Because of the short solenoid plunger stroke and the elimination of friction, there seems to be no limit to the endurance of the solenoid coils in "Mach 2" Valves. We back up this statement by guaranteeing the coil life for a minimum of 100 million cycles. For six years "Mach 2" Valves have undergone test. Valves have been placed in some of the toughest applications we could find to test their performance capabilities in actual service before introducing them to the market. Some were installed in plants where they were subjected to very fast-cycling, continuous operation. Others have been operating where they are exposed to excessive dirt, dust and dampness, and in all cases the "Mach 2" Valves are performing flawlessly. In fact, some operators balked at having us remove them for inspection. To test the new waterproofing treatment of the "Mach 2" coils, one of the units was completely submerged in a container of water on April 26, 1959, and it is still functioning perfectly.



Crescent "Mach 2" 4-Way Valve on a roofing paper machine. This machine operates 24 hours per day, 7 days per week.



Large printing press used to imprint cardboard cartons. "Mach 2" 3-Way Valve controls spray nozzles which apply "offset spray." Production speed of this machine is 2000 cycles per hour.



This Crescent "Mach 2" 4-Way Valve operates the hopper doors at a cement batching plant. The valve has been operating at 1400 cycles per day surrounded by dry cement. We actually had to dig the cement away from the valve to get a picture.

### Write for the "Mach 2" Catalog

Crescent® "Mach 2" Solenoid Pilot Operated Air Valves represent a significant breakthrough in "the cycling speed barrier" and in valve life and operating dependability. We hope you will approve of the unusual name, "Mach 2." We know you will approve of the low-cost, downtime-free performance the "Mach 2" will deliver on your tough jobs. Please write to Barksdale Valves, 5125 Alcoa Avenue, Los Angeles 58, California, and request an advance copy of the "Mach 2" catalog.



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# ...Fluid Power news

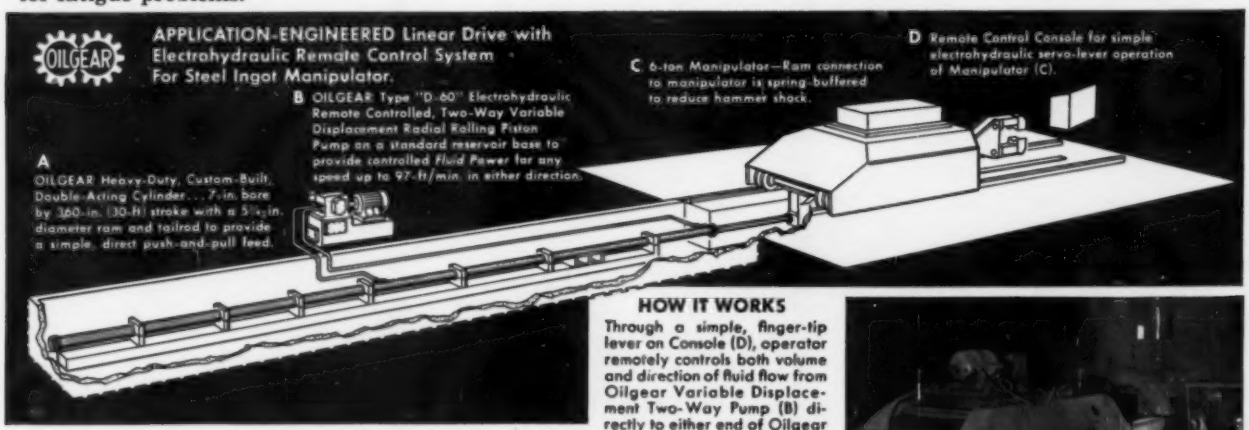
**REPORT NO. 11,801 REMOTE CONTROLLED INGOT MANIPULATOR**

From Oilgear *Application-Engineering* Files

## HOW OILGEAR DRIVE SYSTEM ON INGOT MANIPULATOR IMPROVES CONTROL—CUTS DOWNTIME

**DATA:** Replace an electric variable speed drive on a 6-ton ingot manipulator because of excessive maintenance downtime, high rebuilding and replacement costs. Initial replacement plans called for a hydraulic variable speed drive directly to manipulator wheels, retaining customary practice of operators riding on manipulator. A job study revealed that while feeding an ingot under the open frame steam hammer, forward motion is momentarily stopped by each hammer impact—frequently bouncing manipulator wheels in the air, causing traction, speed control, shock, and operator fatigue problems.

**Basic Manipulator Drive Requirements were re-evaluated as follows: 1.** Remove drive from manipulator to reduce shock-provoked maintenance downtime. **2.** Drive to be independent of wheel traction to improve feed and control. **3.** Provide stepless, remote speed control from zero to maximum in both directions. **4.** Withstand severe shock, vibration, heat, and dust on a continuous 16-hour day basis. **5.** Reduce operating, maintenance, and installation costs. **6.** Provide for future incorporation of hammer control with remote manipulator console.


OILGEAR
APPLICATION-ENGINEERED Linear Drive with Electrohydraulic Remote Control System For Steel Ingot Manipulator.
A OILGEAR Heavy-Duty, Custom-Built, Double-Acting Cylinder . . . 7-in. bore by 360-in. (30-ft) stroke with a 5½-in. diameter ram and tailrod to provide a simple, direct push-and-pull feed.
B OILGEAR Type "D-60" Electrohydraulic Remote Controlled, Two-Way Variable Displacement Radial Rolling Piston Pump on a standard reservoir base to provide controlled Fluid Power for any speed up to 97-ft/min. in either direction.
C 6-ton Manipulator—Ram connection to manipulator is spring-buffered to reduce hammer shock.
D Remote Control Console for simple electrohydraulic servo-lever operation of Manipulator (C).

### HOW IT WORKS

Through a simple, finger-tip lever on Console (D), operator remotely controls both volume and direction of fluid flow from Oilgear Variable Displacement Two-Way Pump (B) directly to either end of Oilgear Custom Cylinder (A). Only two pipe lines are required. Power input is used only in proportion to work performed, as no pump output power is wasted in direction control valves, external relief valves, flow control valves, auxiliary components, or excessive piping. Stepless, infinitely variable, smooth, steady manipulator speeds are instantly available in either direction. Fluid flow and pressure decelerate to zero as flow direction is changed—flow and pressure then accelerate to any selected amount in the new direction . . . reversal is smooth-cushioned — shock is eliminated. Controlled acceleration and deceleration; hydrodynamic braking; automatic pressure and flood lubrication; continuous filtration of power fluid . . . all are inherent features of Oilgear "Any-Speed" Drive Systems.

Hammer operator indicated Oilgear-powered Manipulator with 5300-lb ingot.

Manipulator operator indicated. Cut-off of second 9-in. square, 90-in. bloom worked from one ingot.

**SOLUTION:** An Oilgear Linear Drive and Electrohydraulic Control System as shown above schematically. This departure from customary manipulator drives has proved—*in over two years of operation*—to have the following advantages: **1.** Lower operating costs . . . previous manipulator averaged 12% to 15% downtime every 16-hour day for repair and adjustment of drive and control components. **2.** Direct push and pull linear drive is a more positive, smoother, shockless feed—NOT affected by variations in wheel traction. **3.** Remote console with simple electrohydraulic servo control eliminates operator discomfort and fatigue. **4.** Cylinder is protected below floor—"Power-Pak" is mounted away from heat and dust of work area. **5.** Constant, automatic overload protection insures longer life, prevents damage.

System was selected due to Oilgear's reputation for trouble-free reliability, long life, simplicity, and on-the-job-proved performance of the following *Oilgear-Powered* equipment in this user's plants . . . 300-ton ingot strippers . . . large forming presses . . . tube pointing presses . . . hydrostatic testers . . . stripping presses . . . pipe benders . . . seamless steel tube piercers . . . planers . . . cut-off machines . . . tube threaders—operating efficiently—in constant, daily use—some have been in service for more than 20 years.

**User Reports**—" . . . well pleased with the steady feed rate at both low and high speeds . . . we'll go to this type of drive when we rebuild or require another Manipulator."

**For accurately controlled linear or rotary power—for the lowest cost per year . . . check with Oilgear!**

*For practical solutions to YOUR linear or rotary Controlled Motion problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . . . .*


**THE OILGEAR COMPANY**

*Application-Engineered Controlled Motion Systems*

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# MARVEL

# FOR DEPENDABLE PROTECTION

## IN-LINE FILTER

**CAPACITIES:**
Up to 60 G.P.M.

**PIPE SIZES:**
(at both inlet and outlet)
¾"—1"—1¼" and 1½" **NPTF.**
1⁵/₁₆-12, 1⅝-12 and 1⅞-12 **J.I.C.**

**FLANGE CONNECTIONS:**
1¼" and 1½"

**BY-PASS VALVE:**
Available with or without By-Pass Valve.

*For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.*

## Synclinal SUMP TYPE

**CAPACITIES:**
5—8—10—20—30—50—75 and 100 G.P.M.

**PIPE SIZES:**
¾"—1"—1¼"—1½"—2"—2½" and 3".

**CONNECTIONS:**
Coupling—Male Nipple.

**BY-PASS VALVE:**
Not Available.

*For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.*

## Synclinal LINE TYPE

**CAPACITIES:**
5—8—10—20—30—50—75 and 100 G.P.M.

**PIPE SIZES:**
¾"—1"—1¼"—1½"—2"—2½" and 3".

**BY-PASS VALVE:**
Not available.

**OPERATING PRESSURES:**
Up to 80 p.s.i.

*For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.*

## QUALITY – DEPENDABILITY – EFFICIENCY

**QUALITY**—All Marvel Synclinal Filters are designed and constructed of the highest quality materials and workmanship to insure maximum protection on all hydraulic and other low pressure circulating systems. *They Meet J. I. C. Standards.*

**DEPENDABILITY**—*OVER 900 Original Equipment Manufacturers* install them as standard equipment.

**ECONOMY**—The moderate costs of Marvel Synclinal Filters reflect our streamlined production facilities which further enable us to offer—

**IMMEDIATE DELIVERY**

**A phone call can get your shipment on its way TODAY!**

**EFFICIENCY**—Filtering media in all Marvel Synclinal Filters is Monel wire cloth and available in mesh sizes of 20-30-40-50-60-80-100-150 and 200. Stainless wire cloth in these sizes supplied on specification. Before fabrication into Marvel Synclinal Filters, all wire cloth is subjected to rigid inspection at our plant to assure the utmost in filtration efficiency. *Only selected top quality wire cloth is used.*

**EASY MAINTENANCE**—All Marvel Synclinal Filters can be cleaned easily and thoroughly "on the spot" in a matter of minutes, resulting in the equivalent of a brand new filter, ready for another long period of efficient and dependable service. Line type filters operate in any position and may be serviced without disturbing pipe connections.

# SYNCLINAL FILTERS

## on all hydraulic and other low pressure circulating systems

### Bonded SUMP TYPE

**CAPACITIES:**
10—20—30—50 and 75 G.P.M.

**PIPE SIZES:**
1"—1¼"—1½"—2" and 2½".

**CONNECTIONS:**
Coupling—"O" Ring—Male Nipple.

**BY-PASS VALVE:**
Available with or without By-Pass Valve.

*For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.*

### Tandem Synclinal SUMP TYPE

Designed to supply requirements for greater filtering area where installation of two or more single units are not possible due to space limitations in tank.

**PIPE SIZES:**
¾"—1"—1¼"—1½"—2"—2½" and 3".

**CONNECTIONS:**
Coupling—Male Nipple.

**BY-PASS VALVE** Not Available.

*For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids and water.*

### Bonded LINE TYPE

**CAPACITIES:**
10—20—30—50 and 75 G.P.M.

**PIPE SIZES:**
1"—1¼"—1½"—2" and 2½".

**MOUNTING BRACKET:** All sizes are available with provision for mounting bracket, (also for Flange connection with mounting bracket provisions) if desired.

**BY-PASS VALVE:**
Available with or without.

**OPERATING PRESSURE:**
Up to 250 p.s.i.

**OPERATING TEMPERATURES:**
Up to 300° F.

*For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.*

***For further information—write, wire or phone***

## MARVEL ENGINEERING COMPANY

**7227 N. Hamlin Ave., Chicago 45, Illinois • Phone: JUniper 8-6023**

Please send me information on Marvel Filters as indicated.

- ☐ Sump Type
- ☐ Line Type
- ☐ In-Line
- ☐ Tandem
- ☐ For Hydraulic Oil
- ☐ Fire Resistant Fluids
- ☐ For Coolants or Lubricants
- ☐ For Water

AH-11

*Name*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

# FLUID POWER LINES

## about hydraulics & pneumatics

***MAKE YOU OR BREAK YOU . . .*** It's been pointed out to us recently that one difference between fluid power design in the U. S. and Europe is careful attention to detail in foreign design. These details are often overlooked in our designs and corrected later as "bugs". One detail that can contribute to the success or failure of a machine is the use of quick connect couplings which permit opening a fluid line, and often contain valves to seal off the fluid.

What's there to know about a quick disconnect coupling? The special report on page 65 shows that they're highly engineered products whose selection depends on a number of factors. First question the designer must decide is where to use them —where must lines be disconnected frequently to disassemble equipment? Then comes the question of the best coupling for the job. Does it need valves to shut off flow when disconnected? Should these be in only one half of the coupling or both? How strong must it be according to working and surge pressures? How accessible will it be when it's installed and how easy will it be to open and reconnect? You'll have a better understanding of these questions after reading *How to Select Quick Connect Couplings.*

***BETTER BOWLING . . .*** Trouble *strikes* suddenly when an airline filter or lubricator bowl breaks and you have no *spare.* But even worse there's a safety hazard of shattering plastic. Some of the recent troubles can be traced to deterioration of plastic bowls in chemical atmospheres or from fire-resistant lubricants used in air compressors. Bowl manufacturers are alert to the problem and are supplying metal bowls, metal shields, and reinforced plastic, to overcome the hazard. Learn more about them in *Protecting Air Lubricator and Filter Bowls.*

***THOSE SERVOVALVES . . .*** Two articles this month discuss design and application of servovalves. The second part of Werner Holzbock's first prize winner *Principles of Servovalves* concentrates on design variations of the jet-pipe principle. *Electrohydraulic Servovalves in Industry* concludes the 3-part series with a roundup of five applications.

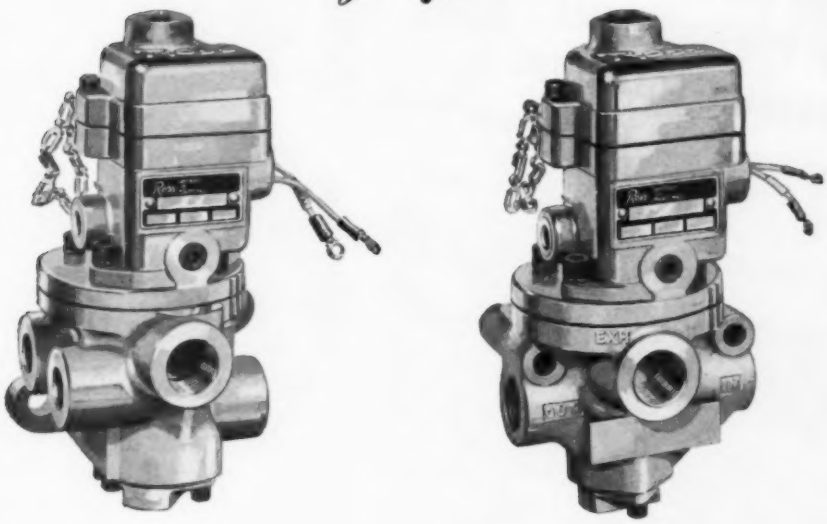
***SHOCK ON TV . . .*** Just as fascinating as any western or private eye episode is the picture of pressure surges you can see on an oscilloscope. Connect a pressure transducer into the hydraulic system, then go through the operations that produce surges. Photograph the cathode-ray display for a permanent record of what happens to pressure under various shock conditions. More details in *Looking at Shock,* page 96.

***GONE ARE THE DAYS . . .*** Back when aviators wore goggles, and awestruck crowds squinted at daredevil barnstormers, the word *aircraft* had a glamour all its own. But in the world of the Sixties the field has outgrown this label. *Aerospace* is the name we've selected for our editorial section covering commercial and military manned aircraft, missiles, spacecraft, and ground support equipment. Each month you'll find articles on design and operation of fluid systems, from the silos deep below the ground to the probes in outer space.

***MR. CLEAN . . .*** Convair's Howard Davis, who is also one of H & P's more prolific Aerospace Advisory Editors, has written about one of the industry's toughest problems—dirt. *Understanding Contamination* is a review of the state-of-the-art, and the clean-up tools that have been developed so far.

# Ross

## *Proudly presents*



THE NEW "HEADLINE" SERIES

*A complete new series of inline valves, sizes one-quarter inch through one and one-half inch, straightway, 3-way and 4-way. These valves, size for size, will operate faster, longer, and provide greater capacity than any other valves we have been able to find.*

*When the price, quality and performance and Ross reputation are taken together in evaluating this series, it represents probably the best valve value available today. Before you specify any valve after today, you owe it to yourself to look into the "headline" series. Write for full information.*

---

**Ross** OPERATING VALVE COMPANY

105 EAST GOLDEN GATE AVE. • DETROIT 3, MICHIGAN

# FROM MIDGET TO MAMMOTH

# Decco®

## GIVES YOU DEPENDABILITY AND TOP PERFORMANCE IN INDUSTRIAL SOLENOIDS

**60 CYCLE FORCE CHARACTERISTICS IN POUNDS**

| STROKE IN INCHES | | ZERO | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 5/8 | 3/4 | 7/8 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MODEL 01 | 100% E | 4.75 | 4.1 | 2.75 | 2.2 | 1.95 | 1.85 | 1.75 | 1.7 | | | | |
| | 85% E | 3.75 | 2.7 | 1.85 | 1.50 | 1.35 | 1.25 | 1.15 | 1.1 | | | | |
| MODEL 02 | 100% E | 5.5 | 5.0 | 3.9 | 3.1 | 2.8 | 2.6 | 2.5 | 2.4 | | | | |
| | 85% E | 4.5 | 3.6 | 2.7 | 2.0 | 1.9 | 1.8 | 1.6 | 1.5 | | | | |
| MODEL 13 | 100% E | 5.5 | 3.25 | 2.55 | 2.25 | 2.25 | 2.15 | 2.1 | 2.0 | | | | |
| | 85% E | 4.0 | 2.3 | 1.7 | 1.6 | 1.5 | 1.5 | 1.4 | 1.4 | | | | |
| MODEL 15 | 100% E | 8.0 | 7.0 | 5.8 | 5.25 | 4.75 | 4.6 | 4.5 | 4.5 | | | | |
| | 85% E | 6.0 | 4.85 | 4.00 | 3.35 | 3.3 | 3.25 | 3.25 | 3.1 | | | | |
| MODEL 16 | 100% E | 12.0 | 8.5 | 7.15 | 6.75 | 6.6 | 6.5 | 6.5 | 6.4 | | | | |
| | 85% E | 10.0 | 6.1 | 5.15 | 4.75 | 4.6 | 4.5 | 4.5 | 4.5 | | | | |
| MODEL 17 | 100% E | 16.0 | 11.2 | 9.9 | 9.0 | 8.5 | 8.1 | 8.0 | 8.0 | | | | |
| | 85% E | 14.0 | 8.2 | 7.0 | 6.3 | 6.2 | 6.1 | 6.0 | 6.0 | | | | |
| MODEL 18 | 100% E | 18.5 | 14.5 | 12.25 | 11.4 | 11.0 | 10.5 | 10.25 | 10.25 | | | | |
| | 85% E | 16.0 | 10.5 | 9.0 | 8.25 | 7.75 | 7.5 | 7.25 | 7.25 | | | | |
| MODEL 20 | 100% E | 25.0 | 18.0 | | 13.5 | | 12.5 | | 12.5 | 12.5 | 12.25 | | |
| | 85% E | 20.0 | 12.0 | | 9.0 | | 8.5 | | 8.5 | 8.5 | 8.5 | | |
| MODEL 21 | 100% E | 35.0 | 20.0 | | 16.0 | | 15.0 | | 15.0 | 15.0 | 15.0 | | |
| | 85% E | 25.0 | 14.0 | | 10.5 | | 10.25 | | 10.0 | 10.0 | 10.0 | | |
| MODEL 51 | 100% E | 40.0 | | | 23.0 | | 21.0 | | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| | 85% E | 30.0 | | | 17.0 | | 15.5 | | 14.5 | 14.5 | 14.5 | 14.5 | 14.5 |
| MODEL 52 | 100% E | 45.0 | | | 28.0 | | 25.0 | | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 |
| | 85% E | 33.0 | | | 19.0 | | 17.0 | | 17.0 | 17.0 | 17.0 | 17.0 | 17.0 |
| MODEL 53 | 100% E | 50.0 | | | 37.0 | | 32.0 | | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 |
| | 85% E | 36.0 | | | 25.0 | | 22.0 | | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |

**DECCO'S patented construction and finest quality materials have greatly extended the service life of the solenoid. Silicon steel laminations give top efficiency. Hardened beryllium-copper plungers reduce friction and wear. Shock absorbing construction assures long service life. Non-magnetic, stainless steel striker-plates . . . heavy Nylclad magnetic wire . . . high temperature flow-point, molded nylon bobbins, all contribute to the dependability and stamina which make DECCO solenoids the best buy in the market today.**

**There is a type, model and size DECCO solenoid for every requirement. Write for DECCO brochures #572 standard models or #581 miniature models.**

Decco SOLENOIDS

## DETROIT COIL COMPANY

2435 HILTON ROAD, FERNDALE 20, MICHIGAN

**IN HYDRAULIC DESIGN**

# Use the IMO Pump for your high capacity requirements

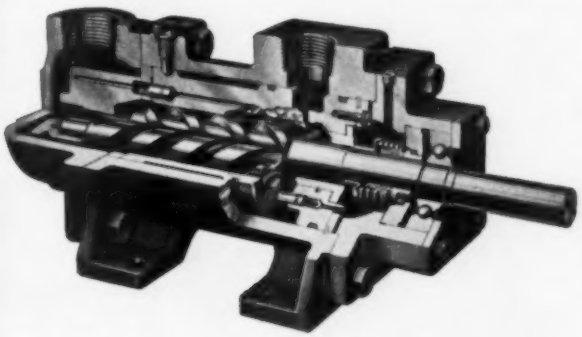
**Big money, space savings—single IMO pump delivers up to:**
**3000 gpm @ 300 psi • 900 gpm @ 500 psi**
**400 gpm @ 1250 psi • 275 gpm @ 3000 psi**

The De Laval IMO pump is unique. It may often replace two or more other type pumps in your design because of its high capacity. In the illustration shown here, the IMO pump is used to actuate a freight car unloader, designed by Straight Engineering Company. In addition to high capacities in a single pump, the IMO also gives you:

- Quiet operation—the proven pump for hydraulic elevators.
- High speed operation without sacrificing performance—ideal for 3500 and 1750 rpm motor speeds.
- Least pulsation of any rotary pump—ideal for machine tool applications.
- Dependable, long life operation—"the" pump for critical services on naval vessels.
- High suction lift capability—eliminates need for supercharging.
- Rugged design—nodular iron case utilized for pressures over 500 psi.
- Exceptionally high mechanical efficiency—means longer pump life.

The IMO has been time-tested and proven in the following applications: machine tools, presses, fan drives, pumping jacks, elevators, water level controls on dams, turbine governor controls, furnace controls, fire trucks—to rotate and raise ladders, and hydraulic systems for the U. S. Navy.

If you want more information on the versatile IMO pump, write for Bulletin 3200.



DE LAVAL **STEAM TURBINE COMPANY**
90e NOTTINGHAM WAY, TRENTON 2, N. J.

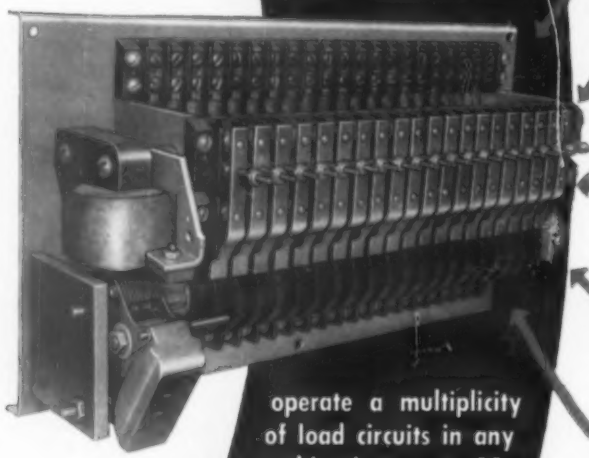
DL 333

A NEW APPROACH TO MACHINE PROCESS CONTROL

# Step Sequencing

the new Eagle Step Switch

use any type of time or sensing device to advance the Eagle Step Switch



PUSH BUTTON

LIMIT SWITCH

INTERVAL TIMER

PRESSURE CHANGE

LEVEL CONTROL

operate a multiplicity of load circuits in any combination up to 19 circuits

**This new Eagle Step Switch also provides:**

1 SEQUENCING INTERLOCK when used with multiple indexing circuits.

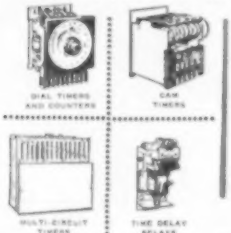
2 10 AMP SWITCH CONTACTS control load switches direct — no need for load relays.

3 MECHANICAL CIRCUIT INTERLOCK by cam action — eliminates interlocking relays.

4 115 VOLT COIL operates direct on AC with heavy duty ratchet mechanism — insures long life.

Write us regarding your count problem, or see your local phone directory or Thomas Register under the heading, "Timers, Electric" for your nearest Eagle Signal representative.

OTHER POPULAR HIGH QUALITY EAGLE TIME-COUNT CONTROLS



BLISS EAGLE SIGNAL COMPANY • Moline, Illinois

A DIVISION OF THE GAMEWELL COMPANY, AN E. W. BLISS COMPANY SUBSIDIARY

MANUFACTURERS OF A COMPLETE LINE OF INDUSTRIAL TIME-COUNT CONTROLS

Circle 45 on Time-Saver Card

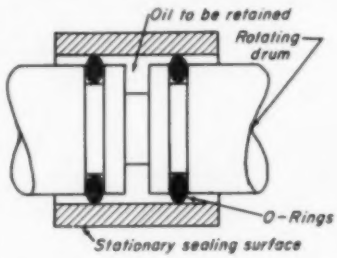
# LETTERS to the editor

Address your letters to: Editor, HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

## Rotary hydraulic seal

TO THE EDITOR:

We are in need of rotary hydraulic oil seals that will withstand pressures of 500 psi maximum, and surface speeds of 1200 ft/min. These seals should be in




various diameters from 4½" to 16" OD. Can you suggest any manufacturer who may do this type of work? We would like something of an O-ring type as suggested in the diagram, or will consider anything that will work.

HARVEY S. MIZEL
Sales Manager
Western Pipe & Tube Co., Inc.
Pueblo, Colorado

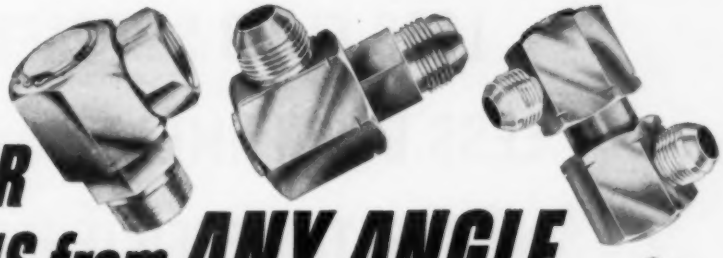
*There are several companies who manufacture a rotary seal which permits transferring fluid under pressure from a stationary member to a rotating one. However we are not sure that they would be suitable for your application. Perhaps other readers have suggestions.*

## High torque, low speed motors

TO THE EDITOR:

On page 14 of the June 1960 issue there is a letter from Mr. R. A. McCullough and your answer, both in regard to high torque, low speed hydraulic motors. We would like tear sheets of the article "High Torque Motor Has Radial Crank Design" referred to in that letter. We are

Continued on page 16



# APPROACH YOUR DESIGN PROBLEMS from ANY ANGLE

## with Eastman Low Cost Industrial SWIVEL CONNECTORS

Licensed Under Pat. No. 2481404

Yes, you can approach your design problems from *any angle* — from any of the six sides of EASTMAN'S *newly improved* Industrial Swivel Connector.

Never before has any fitting equaled its adaptability and versatility. You can stack them, line them up parallel, horizontal or vertical . . . in a "T," if need be.

Not only can you simplify design problems, but you can improve the maneuverability of your equipment . . . raise or lower buckets or blades. You are able to change the angle of the cut right or left, up or down . . . *on the go.*

EASTMAN Industrial Swivel Connectors eliminate costly hose failures due to excessive flexing; permit use of shorter lengths of hose and help eliminate complicated assemblies.

Improved interior design provides "balanced" fluid flow *at any angle*. Chrome hardened, cadmium plated interior surfaces, burnished to a mirror finish, improve performance. SIX sealing rings: 2 leather dust seals, 2 synthetic back-up washers and 2 quad rings of oil-resistant rubber (−40° to +200°) assure dust-free field service and less down time.

If you have been "designing around" Swivel Connectors because of high cost . . . rest assured that EASTMAN'S Industrial Swivel Connectors will not only reduce your original cost but lower your customers' operating costs as well.

Exhaustive Tests at 3000 p.s.i. through 1½ million cycles, with the connector covered with abrasives and dirt, simulating field conditions, proved EASTMAN'S Industrial Swivel Connector satisfactory in every respect and did not cause failure of any kind.

**Cut corners while you cut costs with these economical Eastman Industrial Swivel Connectors.**

**Eliminate installations of lengthy, complicated hose assemblies, junction boxes and multiple adapters.**

**Improve uniform power delivery and operating efficiency, reduce costly field replacement and down time.**

- **LOW TORQUE**—Freedom from friction, even under high pressure.
- **WIDE RANGE**—Operating pressures up to 3000 p.s.i. trouble-free operation through wide temperature range (−40° to +200°).
- **ROTATION**—Full 360° for all manifolds.
- **SIZES**—Steel, plated for corrosion protection—½", ¾", 1", 1¼". Other sizes available on request.

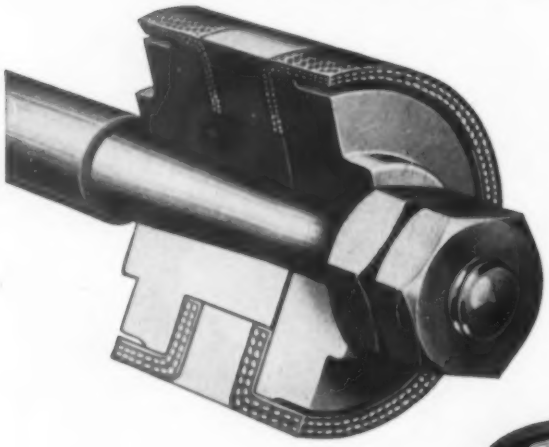
*Write for* Technical Bulletin No. 59 on Eastman's new improved swivel connector.

**Eastman** MANUFACTURING COMPANY
DEPT. AH-11 MANITOWOC, WIS



Circle **47** on Time-Saver Card

# LESS FLUID SLIPPAGE!
# LESS DOWNTIME!
# GREATER EFFICIENCY!



*Darcova Pumcup*

...in hydraulic and pneumatic mechanisms, reciprocating pumps

*Darcova 45° Bevel Type Pumcup*

THE BIG DIFFERENCE you'll find in Darcova Pumcups is that they operate at full efficiency *throughout their entire life.* This means fluid slippage is virtually eliminated.

And because fewer replacements are necessary, you have less downtime. Users report that Pumcups *outlast ordinary packings at least 3 to 1!*

Pumcups are available in three textures—hard, medium and soft. Also in regular or 100% nylon composition. Sizes range from ¾" to 20". For all the facts on Pumcups, write for Bulletin **5903.**

**DARLING VALVE & MANUFACTURING CO.**
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP

TRADE MARK
PUMCUPS

Circle **40** on Time-Saver Card


## LETTERS

interested in high torque, low speed, hydraulic motors as drivers for extrusion machines and agitators in autoclaves. In the arrangement we plan, the use of these motors will eliminate the costly gear boxes generally used.

R. K. WALTERS,
Manager Engineering Dept.
Shell Chemical Co.
New York, N. Y.

### High pressure hydraulics

TO THE EDITOR:

I wish to obtain more information on hydraulic equipment in the 10,000-psi range, such as: control valves, pneumatic hydraulics controls, pilot control valves, relief valves.

S. R. FULTON
B. F. Goodrich
Akron, Ohio

*We have sent names of manufacturers we know who specialize in 10,000-psi hydraulics.*

### High speed air motor

TO THE EDITOR:

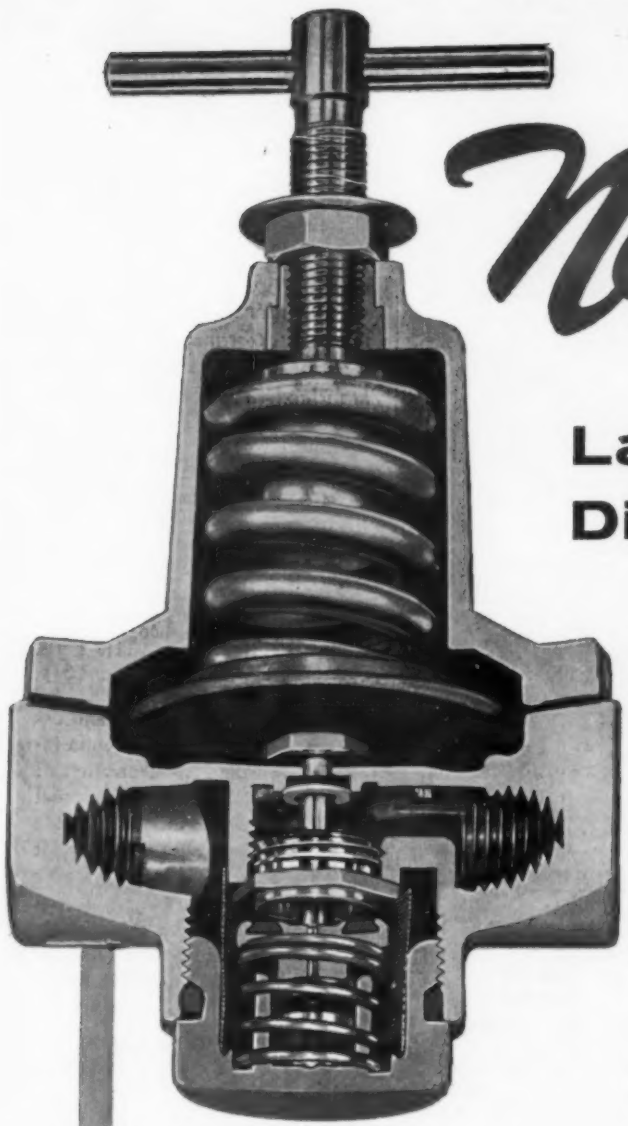
On page 119A of your 1960-61 FLUID POWER DIRECTORY there is a short article on roots motors. We would like very much to secure further information on this type of motor and learn who the manufacturers are.

We have manufactured industrial pneumatic vibrators for several years, and have recently used positive displacement air motors for some of the larger machines. The vane type air motors we are now using work very well at moderate speeds, but many jobs require higher speeds. Therefore we feel that the motor described in this article would be well worth looking into for operation at speeds of about 10,000 rpm.

CARL G. MATSON
Plant Superintendent
Vibrator Manufacturing Co., Inc.
Neponset, Ill.

*Name of the manufacturer has been sent. Perhaps some of our readers have had experience with air motors at these high speeds.*

*All Pressure Regulators are not alike*



# Norgren

## Large effective Diaphragm area

*provides closer pressure regulation*

The extra-large effective diaphragm area in Norgren Pressure Regulators provides maximum sensitivity to fluctuating operating conditions.

***Any slight deviation*** in regulated pressure, either as a result of fluctuating line pressure or varying flow demand, results in a greater total change in the force exerted by the diaphragm against the regulating spring. The valve immediately provides compensating action. This makes possible a highly uniform regulated pressure.

***Regulator performance is better*** because a more stable regulated pressure is maintained over a wide range of operating circumstances.

***The Norgren diaphragm*** is made of nylon-reinforced Buna N synthetic rubber, a combination that provides extra-long service, resulting in longer regulator life, more dependable operation and minimum maintenance.

**For complete information on all your regulator needs, ⅛" to 2", call your nearby Norgren Representative listed in your telephone directory—or WRITE FACTORY FOR DESCRIPTIVE LITERATURE.**

***Norgren Pressure Regulators give you these important features:***

Balanced Valve Construction—improved regulator performance

Large Nylon-reinforced Buna N Synthetic Rubber Diaphragm—long service life

Baffle and Siphon Tube—increased accuracy

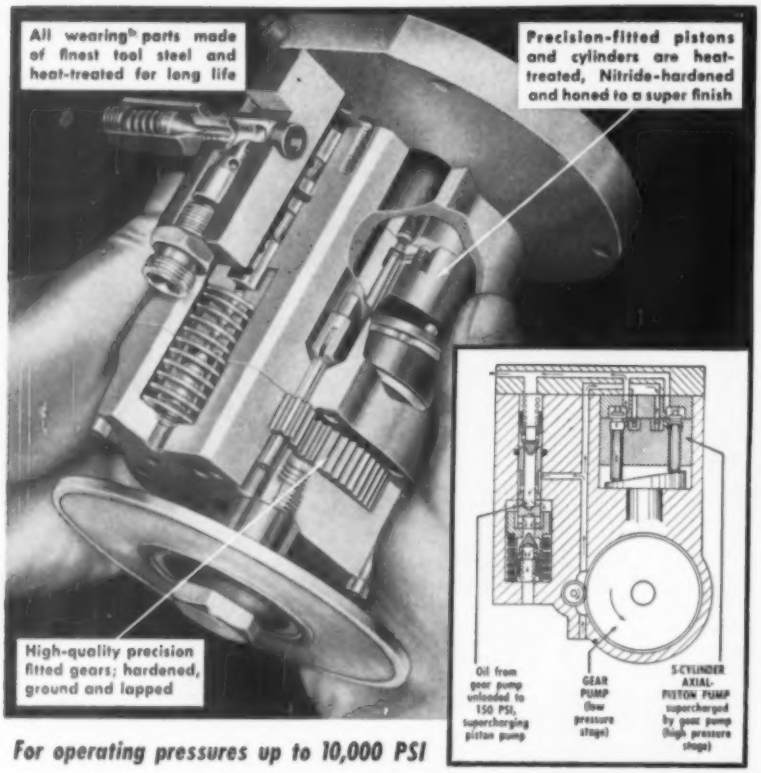
Large Passages and Valve Openings—large flow capacity

Easy servicing while still on air line

Flexible Valve Pin—assures better seating

**C. A. NORGREN CO.** FOUNDED IN 1926

**3402 SOUTH ELATI STREET • ENGLEWOOD, COLORADO**


All wearing parts made of finest tool steel and heat-treated for long life
Precision-fitted pistons and cylinders are heat-treated, Nitride-hardened and honed to a super finish
High-quality precision fitted gears; hardened, ground and lapped
Oil from gear pump unloaded to 150 PSI, supercharging piston pump
GEAR PUMP (low pressure stage)
5-CYLINDER AXIAL-PISTON PUMP supercharged by gear pump (high pressure stage)

*For operating pressures up to 10,000 PSI*

**New, unique 2-stage hi-pressure hydraulic pumping unit—dual-volume, dual-pressure**

- **DELIVERS HIGH-VOLUME AT LOW PRESSURE**
- **2.6 GPM @ 100 PSI**
  **1.75 GPM @ 500 PSI**
  **80 CU. IN./MIN. @ 1,000 PSI**
  **50 CU. IN./MIN. @ 10,000 PSI**

The new and modern OTC "Vanguard" hi-lo hydraulic power package is a precision-built, high-quality unit meticulously crafted for dependable performance and long life. To best utilize the "Vanguard's" exceptional performance, a wide range of accessories are available: your choice of several motors, gasoline engine, 2 and 4-way lever-control valves, 2-way solenoid valve, pressure switch, pressure regulating valve, manifold, reservoirs, gauges, etc.

For detailed information on this advanced, new unit, write:

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RESEARCH · ENGINEERING · DEVELOPMENT
OTC

DESIGNERS AND MANUFACTURERS OF QUALITY HIGH PRESSURE HYDRAULIC COMPONENTS

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# FLUID POWER FORUM

Each month HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

● ***Cylinder manufacturers are working toward standardized cylinder mountings. Would standardization be helpful to you?***

No, standardization would not be helpful. Military applications for cylinders in flight systems are at the mercy of space limitations. Accordingly, each application dictates mounting location and type.

A. ARRIGO
Walter Kidde & Co.
Clifton, N. J.

Based on the experience and excellent success in the petroleum industry with the standardization of flange sizes, ring grooves, seal rings, valve centerlines, etc. by the American Petroleum Institute, it appears that the power cylinder manufacturers are taking a step in the right direction. This action will be applauded by the users for it will permit interchange of equipment.

J. M. LEBEAUX
Oil Center Tool Co.
Houston, Texas

● ***What is your preference for cylinder packing (dynamic) for pistons and rods? O-rings, U-rings, V-rings, cups, flanges, piston rings, etc? Why? What problems have you had with packing? Material, size, shape, supply, leakage, etc?***

For our special cylinders that we have manufactured here in Switzerland to our design, we formerly used O-rings up to 1000 psi and V-rings above that. Applications were mostly for building machinery and, in some cases, agricultural applications. While we never had any trouble, we are now

Continued on page 20

*another* **NEW PRODUCT** *from* Modernair®

# 2 · IN · 1 QUICK EXHAUST DOUBLE CHECK VALVE

Operating on pressure differential, this completely self-contained valve provides rapid, full-flow connection of air from either one of two sources to a common outlet, but not between the two sources. It thus can serve two functions:

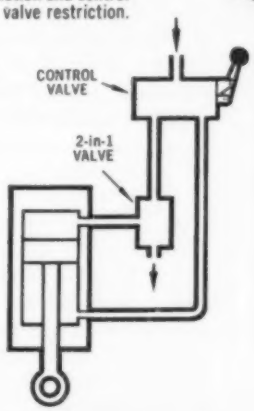
**1.**

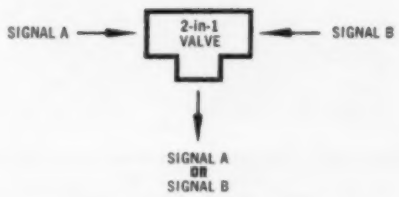
**QUICK EXHAUST VALVE** ... the instant pressure is cut off by the control valve, the pressure differential from the cylinder or work lifts the diaphragm and releases exhaust air from the cylinder to atmosphere with virtually no restriction. Compact (2-in-1) valve can be mounted directly on or close to cylinder, eliminating line friction and control valve restriction.

**2.**

**DOUBLE CHECK VALVE** ... in this function, 2-in-1 valve connects two independent supply or control lines to a common outlet. Ideal for use in two-station control, interlocking and "hold" circuits.

Aluminum-bodied 2-in-1 valve operates at air pressures to 200 psi, is only 1¾" in overall diameter, 2½" long, with ⅜" NPT ports. Only moving part is a Neoprene diaphragm.




Modernair 2-in-1 valves are currently available in ⅜" port size shown with larger port sizes to come. They have scores of money-saving, problem-solving applications in air control circuits. For complete information, see your phone book yellow pages for your nearest Modernair dealer, or write us.

Modernair® CORPORATION

400 Preda Street • SAN LEANDRO, CALIFORNIA • Phone: LOckhaven 2-6485

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MEMBER NATIONAL FLUID POWER ASSOCIATION

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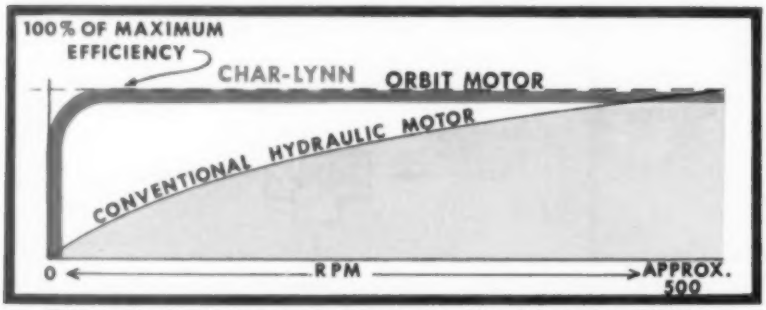
# You've never seen a motor like this!

PAT. NO. 2,821,171

## A High Torque, Low Speed Hydraulic Motor

It's Here—A NEW concept in fluid power mechanics has brought about the development of a totally new fluid motor—A *High Torque—Low Speed* motor.

These motors open up complete new areas for design, never before possible. They offer a practical and economical hydraulic solution to the age-old problem of providing High Torque at Low Speeds for constant and variable speed drives—hydrostatic transmissions and remote controls *without* bulky, costly mechanical drives and gear reducers.




Whereas hydraulic losses make some conventional designs prohibitive at the lower speeds, Char-Lynn ORBIT MOTORS maintain high efficiency over the complete operational range.

- Speeds from 0—800 RPM
- Torques to 3300 inch lbs.
- Starting torque substantially equal to running torque
- Fully reversible — instantaneous starting—stopping
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- 4 types of mountings available
- 3 port sizes—7 power element selections
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Write for complete 8 page brochure on ORBIT MOTORS

Char-Lynn

HYDRAULIC HORSEPOWER PRODUCTS

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FA 1-5761

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# FORUM

tending toward the use of V-rings for all applications. The main reason is the generally increasing pressures which make it easier to use the same design for the few remaining lower pressure applications. So we have quite a universal design which allows us to specify special cylinder sizes (which are identical in the main components anyway) at very interesting prices.

Whenever possible we use standard production cylinders of American or German origin with very good results. In the future we will also use cylinders of British origin because of the European Free Trade Association of which Switzerland is a member.

Our only difficulty was in our power steering now in development where a trial customer used an HD-oil which resulted in deformation and leaking of the neoprene O-rings.


M. P. ESCHLER
Urania Accessories
Zurich, Switzerland


***• What features do you want in the ideal fluid reservoir? Can you get the features you need? What complaints do you have about present reservoirs?***

As a lubrication engineer I am called upon to service many hydraulic systems, where our fluid media is in service. I find two points where considerable improvement could be had if minor changes were made in the design of the reservoir:

1) Where the reservoir is a separate unit, sitting away from the machine proper, most of the time it has a flat bottom and sits directly on the floor. The drain plug is at the bottom of one side, making it difficult to effectively drain the reservoir cleanly. If the reservoirs were constructed so that there would be a common low point, in the bottom plate—with the reservoir setting on short legs (about 2 to 3 inches off the floor) cleaning would be much simpler

and thorough. Such a design would also allow any water entering the system to drain to this low point. A simple valve could be placed at the drain point, so that by cracking slightly, excess water could be drained from the reservoir without disturbing the rest of the fluid media in the system. It would be of considerable assistance in promoting better preventive maintenance to the fluid media—making it easier to keep it clean.

2) Many reservoirs have a simple screen filter at the intake end of the suction pipe, submerged in the fluid media. The only way to clean these screens is to remove the suction pipe. Because of this, I have found this function neglected in the average plant. On rare occasions I run across a reservoir which has a wiper blade mounted on the outside of this filter screen, with an actuating arm extending through the wall of the reservoir, with a turning knob on the end. The operator merely has to give this knob several turns, at frequent intervals, to clear the filter screen. Because it is easily accessible and easy to do, it is done regularly. By providing a simple, easy way for keeping the intake screen clear, chances for clogging of the screen are lessened, enabling the pump to have a full volume inflow of fluid media, at all times. This promotes maximum efficiency of the system.

C. M. KASTLE
Mobil Oil Co.
Baltimore 7, Md.

• ***JIC Standards now approve welded tubing. How will this affect your designs for cylinders and lines?***

It is our opinion that this approval will not affect our work appreciably. In most cases we will not be able to incorporate welded tubing in our designs due to the stringent specifications we have for tubing. We feel that the possibility of small leaks and weaknesses in welded tubing makes it unsatisfactory for most of our work.

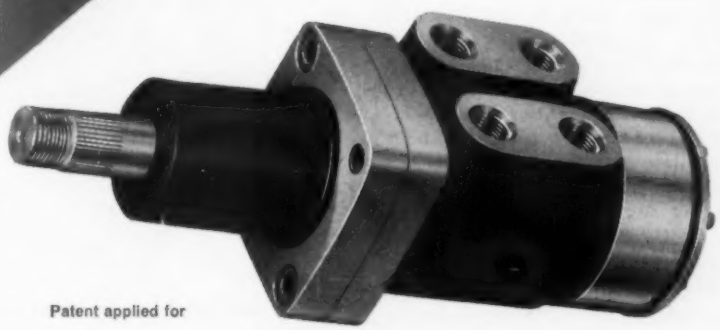
JAMES L. CROSS
Physicist
Jarrett Instrument Co.
Silver Spring, Md.

NEW FLUID STEERING
REPLACES ENTIRE MECHANICAL STEERING SYSTEM

ORBITROL is a completely integrated steering control system that eliminates any mechanical linkage to the axle. The all NEW ORBITROL provides remote rotary servo control with sensory direction and delivery measurement within the same unit... the ideal concept in self-propelled vehicles.

Char-Lynn®
ORBITROL

ORBITROL can be used with any remote actuator, such as a linear cylinder, rotary cylinder, or hydraulic motor. With power off, ORBITROL becomes a pump to furnish means for emergency steering.



Patent applied for

10 Good Reasons for Choosing Char-Lynn ORBITROL for Your Control Needs

- Replaces entire mechanical steering system
- Direct acting—not a booster
- Operates with power off
- Optional steering arrangements
- Easy to install—compact size
- Allows design flexibility • Sound axle design
- Optional mounting
- Reduces steering effort
- Reduces maintenance
- Highly responsive

Write for complete 8 page brochure on ORBITROL

Char-Lynn
HYDRAULIC HORSEPOWER PRODUCTS
2843 26th Ave. So., Minneapolis, Minn.
PA 1-8761

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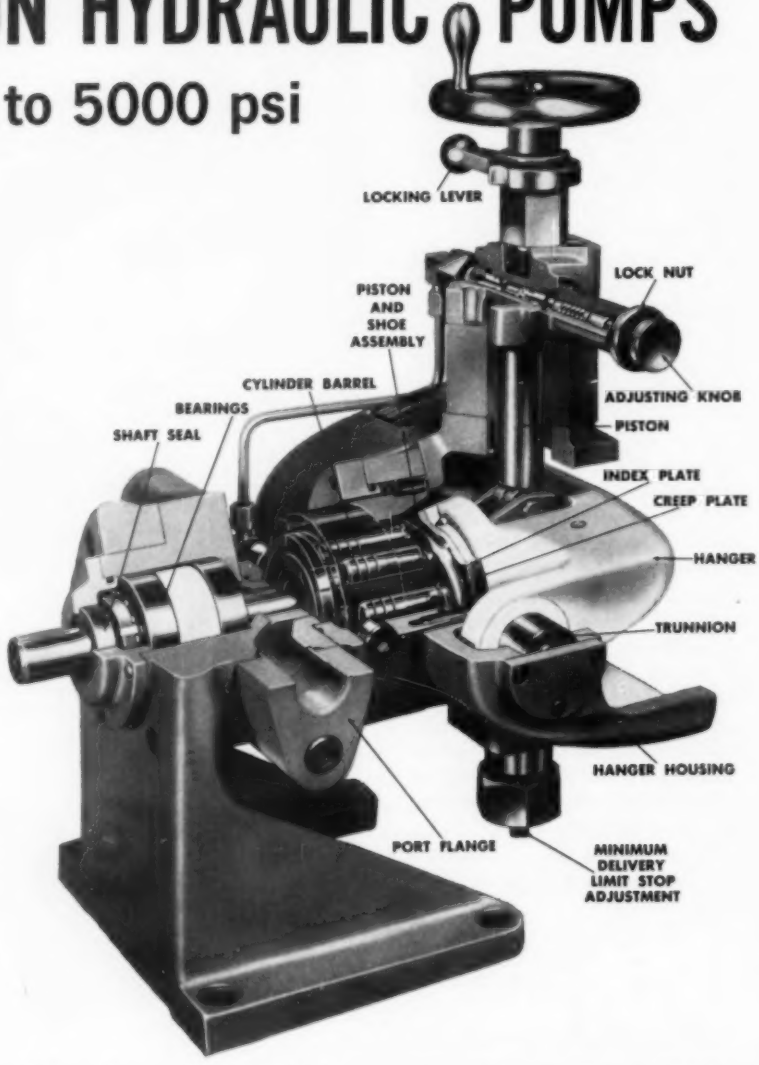
## Design of variable volume

# AXIAL PISTON HYDRAULIC PUMPS

## for systems up to 5000 psi

*By:* Ellis H. Born
*Director of Sales-Engineering*
*Denison Engineering Division*
*American Brake Shoe Co.*




For 5000 psi requirements, the axial piston pump (illustrated) is a logical choice. It operates on the principle of a series of pistons in a common barrel that progressively draw oil into the barrel on the suction stroke and force oil from the barrel into the line on the discharge stroke.

With this simple axial piston design, direct and unrestricted flow into the pumping assembly is possible, eliminating the need for the large flow areas used and the moving seals which, in turn, eliminates maintenance. Direct flow path further insures good suction characteristics —a highly desirable operating advantage for obtaining efficient hydraulic performance.

The port plate of the Denison pump is designed as an axial hydrostatic bearing which balances out the thrust of the cylinder barrel, leaving only sufficient force to create a positive seal contact between the cylinder port plate and the cylinder barrel. Because of reduced thrust, wear on mating surfaces is decreased and pump life is greatly extended at all pressures up to 5000 psi.

Where variable volume is required, it is logically desirable (for efficiency, simplicity and low maintenance) to eliminate the need for varying the position or angle of the cylinder barrel to regulate volume. In the Denison axial piston pump, output is simply regulated by varying cam plate angle. Zero to full flow or flow reversal is regulated by handwheel, hydraulic cylinder, stem, electric motor, compensator or electrohydraulically.

In the Denison design, the line of action of the combined radial load of all pistons is through the roller bearing supporting the cylinder barrel. The use of a large bearing provides non-deflecting support for these radial forces. As a result, unbalanced or twisting offset that would tend to unseat the cylinder barrel from the port plate is eliminated. A continuous, effective sealing action of the barrel against the port plate is maintained to promote high pumping efficiency.

Piston and shoe assembly design also reduces by one-half the number of ball and socket couplings found in other types of axial piston pump construction. The shoes hydraulically balance out all piston thrust, eliminating need for thrust bearings.

Data and specifications on 5000 psi pumps, motors and controls are available from your Denison representative—located in principal cities—to assist you in developing hydraulic systems for maximum efficiency and economy.

**NEW CATALOG FOR DESIGNERS AND ENGINEERS**

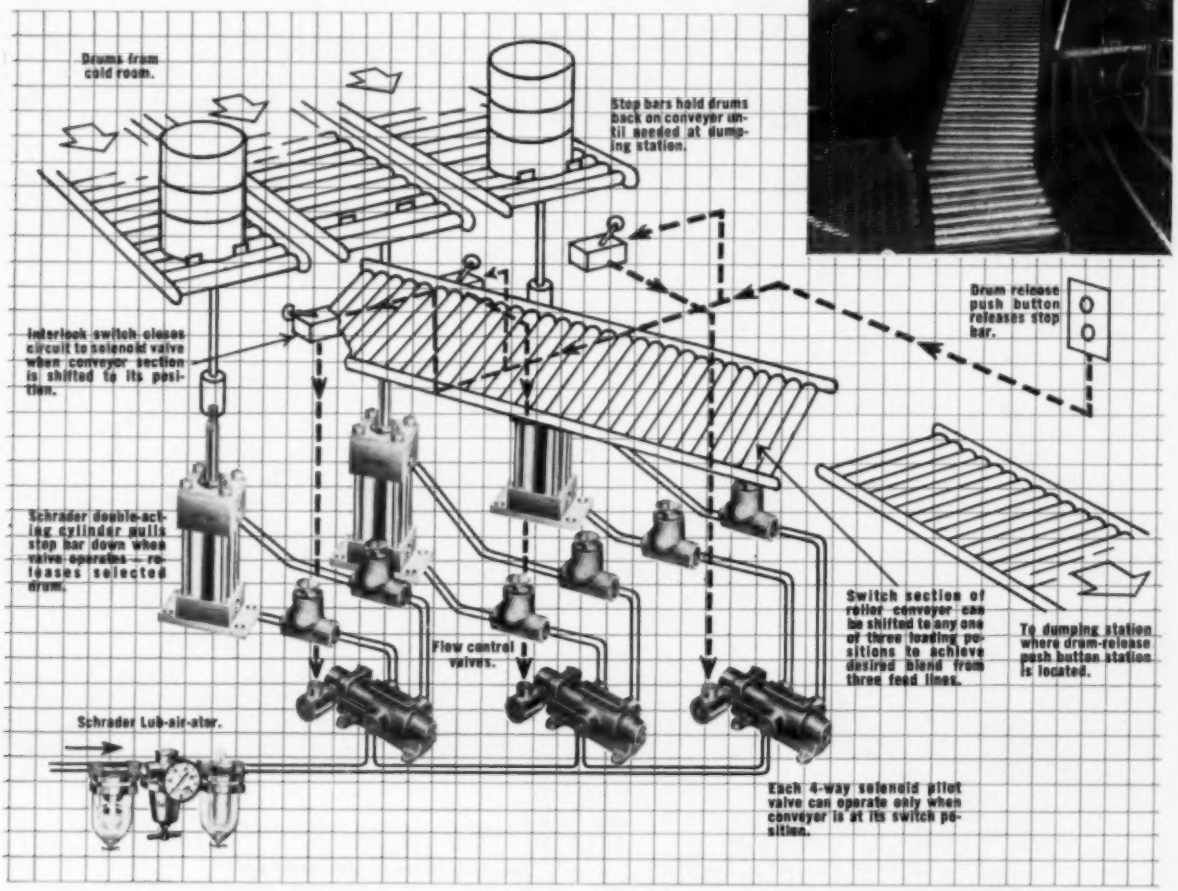
Write for your copy of Bulletin 220—"Hydraulic power to 5000 psi". Includes complete specifications, operating data and applications for Denison's full line of hydraulic pumps, motors and controls.

**DENISON ENGINEERING DIVISION**
**American Brake Shoe Co.**
1166 Dublin Road • Columbus 16, Ohio



Circle **42** on Time-Saver Card

Processors automate even heavy work with air. In a complex frozen juice concentrate blending operation, Plymouth Citrus Products Cooperative, Plymouth, Fla., hooks up Schrader Air Products simply and economically to a gravity conveyor. Full 55-gal. barrels on feed sections roll down to stop bars and are selected in correct order and ratio for dumping. "The Schrader system performs well," says C. Byron Smith, plant manager. "We're handling 200 to 300 barrels a day on this selective conveyer, and could handle more."


Drums from cold room.
Stop bars hold drums back on conveyor until needed at dumping station.
Drum release push button releases stop bar.
Interlock switch closes circuit to solenoid valve when conveyor section is shifted to its position.
Schrader double-acting cylinder pulls stop bar down when valve operates — releases selected drum.
Flow control valves.
Switch section of roller conveyor can be shifted to any one of three loading positions to achieve desired blend from three feed lines.
To dumping station where drum-release push button station is located.
Schrader Lub-air-ator.
Each 4-way solenoid pilot valve can operate only when conveyor is at its switch position.

# PROCESSOR AUTOMATES BACK-BREAKING CHORE WITH SCHRADER AIR PRODUCTS . . . GAINS SPEED, EFFICIENCY, BIG ECONOMIES

Solve difficult problems of handling, conveying and sorting, just like this company . . . with air! Versatile Schrader Air Products take punishing environments in stride, even corrosive atmospheres . . . Work together like magic on American production systems of many different kinds in hundreds of industries.

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*Select from the full Schrader lines to plan your automation of machines. Your Schrader distributor can help you pinpoint what you need. For more data write:*

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*Division of Scovill Manufacturing Company, Incorporated*
**456 Vanderbilt Avenue, Brooklyn 38, N. Y.**

QUALITY AIR CONTROL PRODUCTS



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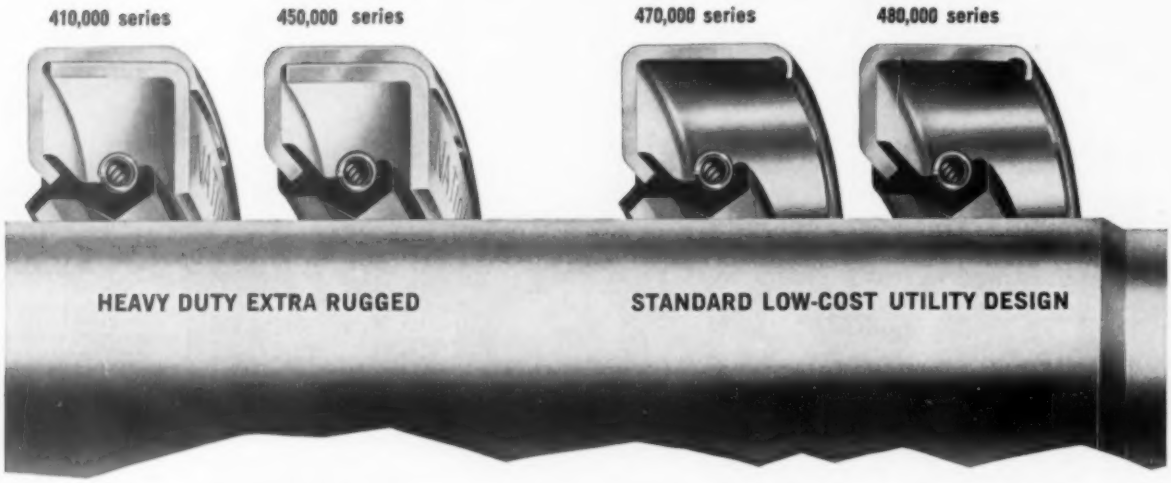
NATIONAL OIL SEAL LOGBOOK

# Presenting...

## A rugged, dependable new shaft seal for a broad variety of applications

## NATIONAL BUD* SEALS

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**Permanent bonded sealing lip, longer life, leakproof sealing**

**Rugged case won't distort under severe press fit**

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**Seal has superior concentricity**

**Sealing materials for temperatures —65° F to 400° F**

**Operates in most oils or industrial fluids**

National Seal engineers — who brought you Syntech® and Micro-Torc* —now offer a ruggedly simple new advance in precision shaft sealing —National BUD (Bonded Universal Design) Oil Seals.

BUD seals are designed for a broad variety of applications, including many where more complex single-lip and double-lip designs were previously specified.

Full details and application engineering help on National BUD or other oil seals are available from your National Seal Division, Field Engineers. See the Yellow Pages under "Oil Seals" or write direct to Redwood City, Calif., home offices.

*TRADEMARK NATIONAL SEAL

**NATIONAL SEAL**

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
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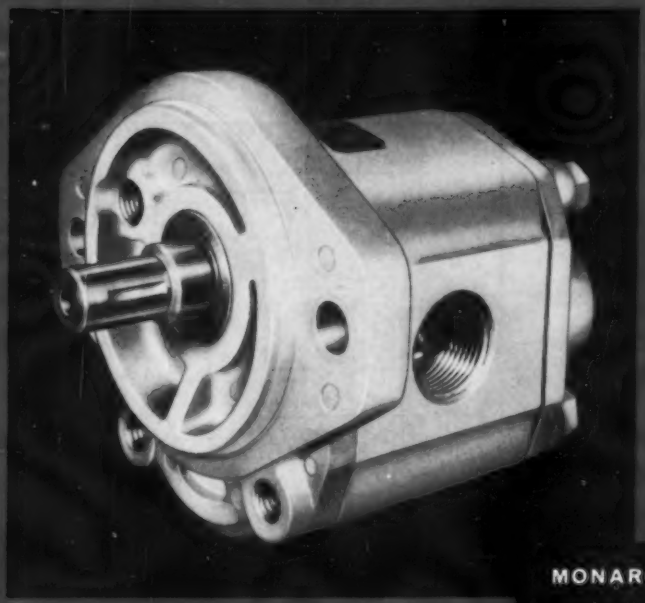
Circle 159 →

From WOOSTER Engineering...

# NEW HIGH PERFORMANCE B-W HYDRAULIC GEAR PUMPS FOR INDUSTRY

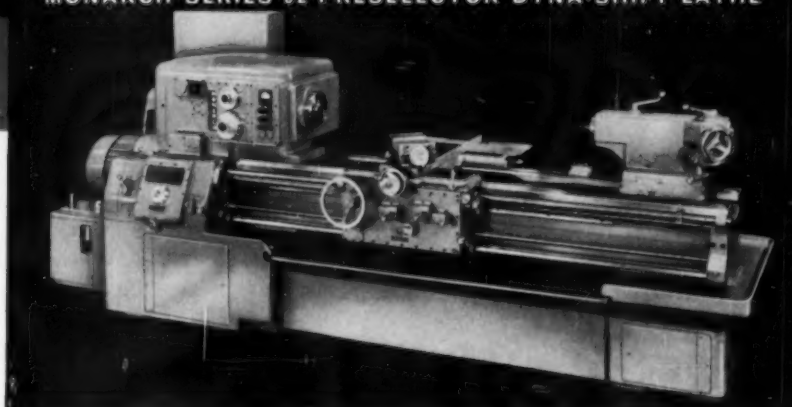


- Greatly Simplified
- Longer Life
- Higher Performance
- AT FAR LESS COST!

**P-2 SERIES** — Displaces 0.2 to 0.9 cu. in.—Speeds to 4000 RPM—Pressure 2000 PSI

*(Available also in other capacities)*

MONARCH SERIES 62 PRESELECTOR DYNA-SHIFT LATHE



## The "Headstock That Thinks" Relies on a BORG-WARNER HYDRAULIC GEAR PUMP

A small B-W pump by Wooster, supplying mist lubrication to the intricate moving parts of the Monarch Series 62 Preselector Dyna-Shift Lathe, keeps this nimble mechanical brain in "calculating" condition. It also supplies power for shifting and clutch operation.

The Dyna-Shift headstock calculates, selects and sets up the correct spindle speed for each diameter of the work piece and indicates it on a dial, enabling the operator to *preselect* his speed changes for succeeding diameters while the machine is actually in operation . . . a remarkable engineering feat by MONARCH.

***Another Demonstration of the Reliability and Adaptability of a BORG-WARNER Product—all at a Greatly Reduced Cost!***

**WOOSTER DIVISION**

**BORG-WARNER CORPORATION, WOOSTER, OHIO**

**INDUSTRIAL HYDRAULICS** / EXPORT SALES—BORG-WARNER INTERNATIONAL 36 SOUTH WABASH AVE., CHICAGO 3, ILL.

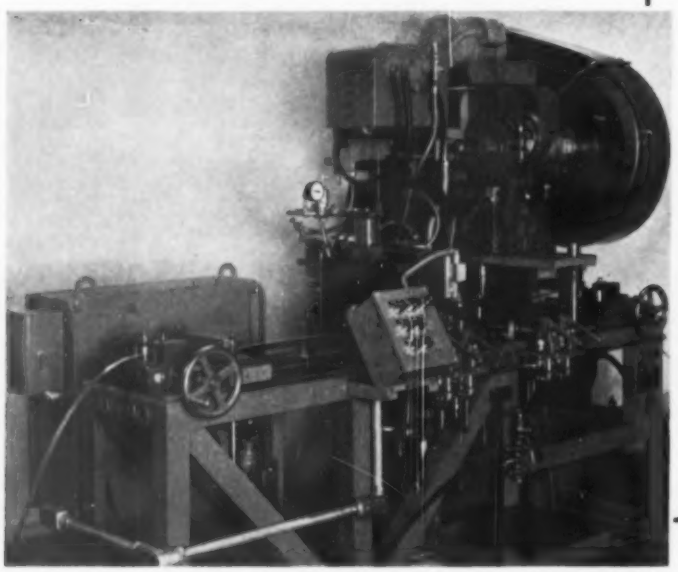
*IT'S A BETTER PRODUCT WHEN BORG-WARNER HAS A PART IN IT*

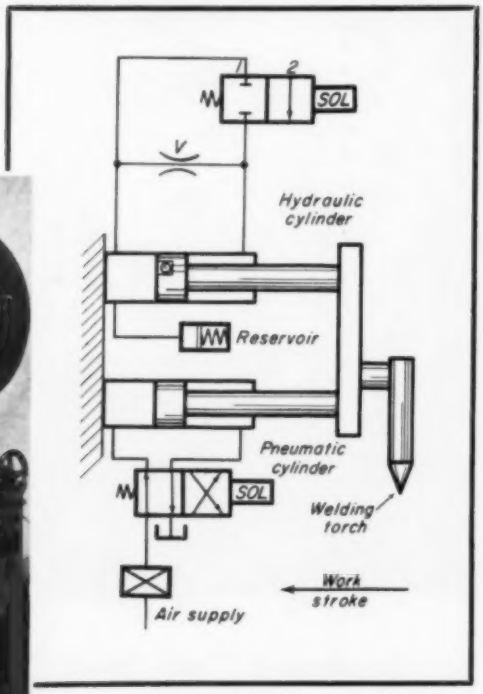
ONE MAN

# BRIEFS

## about fluid power

## *Skip Welding with Hydraulic Control*






Pneumatic and hydraulic cylinders combine to power a strip welder and control its speed. The two cylinders are yoked to a welding torch at one end and to a common base at the other. The pneumatic cylinder moves the welding unit. The hydraulic cylinder controls the welder's speed. Manufacturer is the National Electric Welding Machines Co., Bay City, Mich.

Work is done during the retracting stroke of the cylinders. As the pneumatic cylinder begins to move the welder at the start of the work stroke, the hydraulic solenoid valve is in position *1* (see schematic). Fluid is forced through the flow control valve for slow movement during weld travel. When welding is completed, a limit switch actuates the solenoid valve to position *2*. Fluid bypasses the flow control valve, and the cylinders travel faster to bring the weld torch to the next weld position on the strip. The control valve then shifts back to position *1*, quickly decelerating the welder which resumes slow welding speed. The fluid again travels through the flow control valve, and the welding cycle is repeated. Welder speed is infinitely adjustable from 0 to 150 ipm.

When the cylinders are completely retracted, the pneumatic control valve reverses their direction, and both cylinders extend quickly, ready for the next work stroke. To accelerate cylinder extension, a ball check valve is built into the hydraulic piston. A spring loaded reservoir replenishes the hydraulic circuit. ▼▼▼

## *Cylinders Compensate Press Deflections*

A 100-ton hydraulic C-frame press was designed specially for the critical compression of beryllia, for the University of California's Lawrence Radiation Laboratory, by the Rucker Co., Oakland, Calif.

The huge press resembles a standard C-frame configuration.

Continued on page 30



Circle 72 ➔

# ONE MAN ONE TRADE ONE TOOL

**...your production line back in operation in**

# 30 SECONDS

**(if it's a Hunt PDQ Air Control Valve)**

☑ **accessibility** ☑ **simplicity** ☑ **speed and capacity** ☑ **price and quality**

No bulletin can do it justice...have the Hunt man call. Write to:

**HUNT** HUNT VALVE COMPANY DIVISION OF IBEC SALEM, OHIO

*Quick-As-Wink* AIR & HYDRAULIC CONTROL VALVES

# PARKER PIONEERS AGAIN

## LEAKPROOF PORTS WHATEVER THE FLUID!

NEW
NEW
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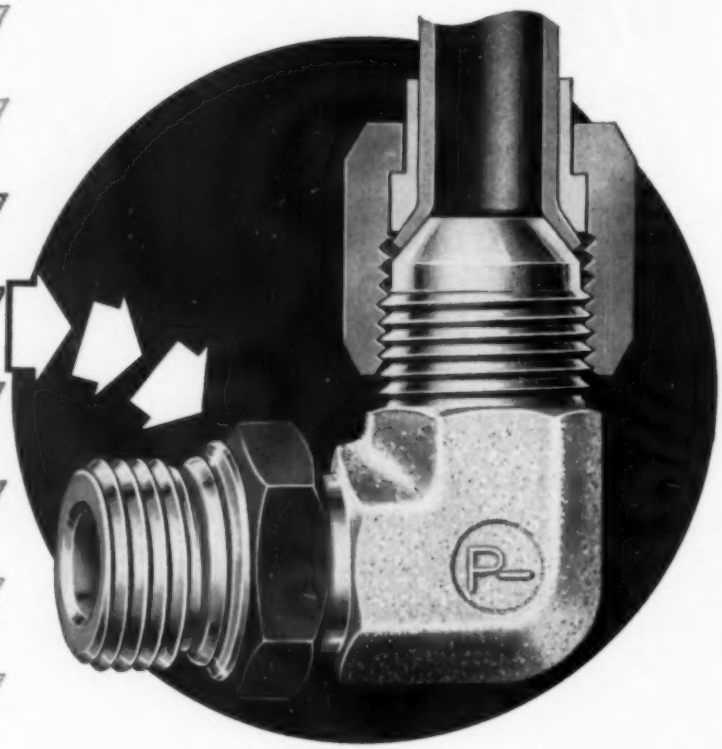
NEW



## PARKER NOW OFFERS A METAL SEAL TO FIT THE S. A. E. STRAIGHT THREAD BOSS

Parker, whose straight thread fittings and straight thread ports have been accepted by S.A.E. (and now by J.I.C.) as industry standards for hydraulic devices, has now developed a **stainless steel** seal for use where the convential, synthetic rubber "O" ring is not acceptable.

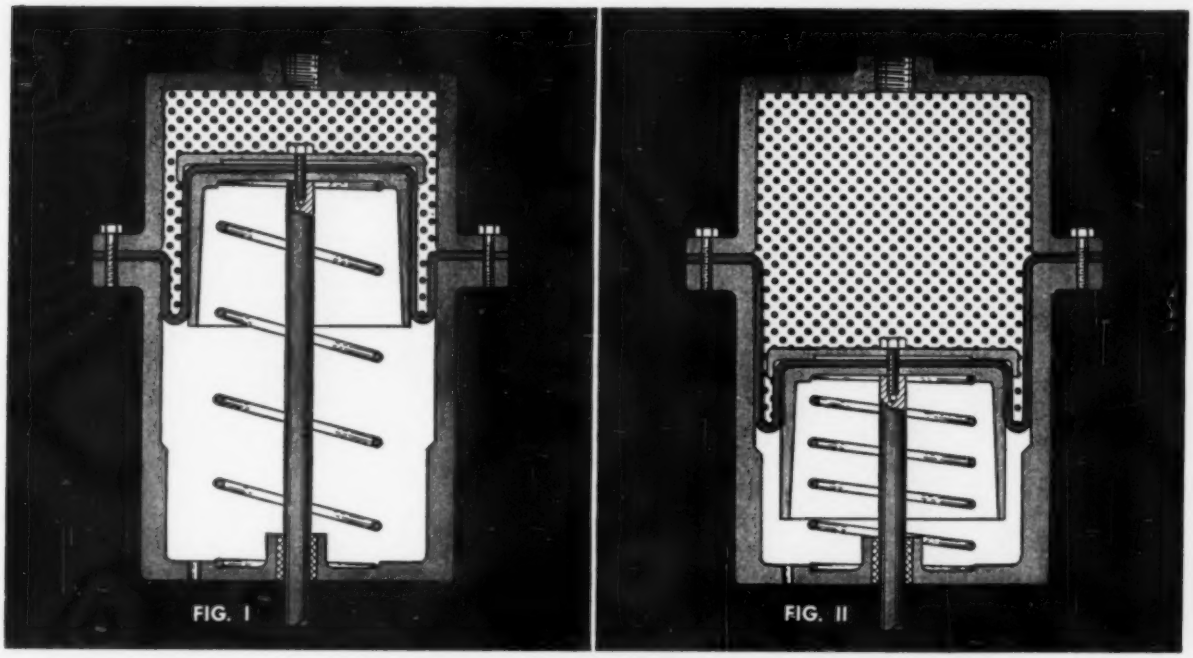
Their new all-metal straight thread fitting features this resilient stainless seal, **which seats within the confines of the S.A.E. straight thread boss configuration.** The new seal cannot be removed from the fitting and, therefore, cannot be lost. It can be used again and again without damage to the boss or to itself. Because it is 304 stainless, it works equally well with every known hydraulic fluid, petroleum-base or fire-resistant.

Parker offers steel and stainless steel straight-thread fittings with stainless seals in both their "Triple-lok®" 37° flare design (illustrated) and their "Ferulok®" flareless, "bite-type" design. Also available from Parker are tools with which to cut the mating S.A.E. boss.

Hydraulic designers who have hesitated to standardize on the leakproof S.A.E. straight thread boss on applications where they could not be sure what hydraulic fluid would be used are invited to write for complete engineering test data on this new development.

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue • Cleveland 12, Ohio
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

3150-72E




*For Hydraulic and Pneumatic Devices*

# Nothing rolls like a Bellofram®

## Rolling Diaphragm. It's frictionless!

The Bellofram Rolling Diaphragm provides ultra-sensitive response in hydraulic or pneumatic devices where frictionless, long-stroke action in small diameter configurations is required . . . and where flex life of millions of cycles is necessary.

These desiderata are achieved through the *rolling* action of a flexible, thin-sidewall diaphragm consisting of a high-tenacity fabric overlay embedded in elastomeric material.

Fig. I shows how Bellofram Rolling Diaphragm conforms to the piston. Fig. II shows how, as the piston descends under pressure, the Bellofram Rolling Diaphragm *rolls* off the piston's sidewall and onto the cylinder's sidewall in a smooth, continuous, frictionless movement.

The Bellofram principle can be applied widely in actuators, pumps, instruments, seals, accumulators, and fluid dampers.

## Which of these advantages are you looking for?

To the designer confronted with situations for which conventional bellows, O-rings, or cup packings are inadequate, Bellofram Rolling Diaphragm offers a constellation of advantages found in no other product:

1. **Friction-free (low hysteresis).**
2. **No break-out friction effects.**
3. **Non-porous and leakproof.**
4. **Constant area in all piston positions.**
5. **Almost infinite flex life (millions of cycles).**
6. **Sensitivity to extremely small pressure changes.**
7. **No mechanical spring gradient.**
8. **Compatibility with practically all environmental gases or fluids.**
9. **Automatic de-icing action.**
10. **Free positioning with complete relaxation at any point in the stroke.**
11. **Does not require close machine finish tolerances on pistons and cylinders.**
12. **Freedom from abrasive wear.**
13. **One hundred stock sizes. Four mounting configurations. Special types and sizes designed to order.**
14. **Excellent temperature stability from —85°F. to 550°F. (from —120°F. to 700°F. in some cases). Wide range of working pressures: 1 inch $H_2O$ to 500 psi (up to 1200 psi in some cases). Effective pressure areas from .028 to 108 square inches. Cylinder bore diameters from .25 to 12 inches. Extended range of stroke (.01 to 12 inches).**

Some territories open for technical sales representatives.

**SEND FOR FREE LITERATURE**

Bellofram Rolling Diaphragms are protected by U.S.A. and foreign patents.

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*Please send free literature.*

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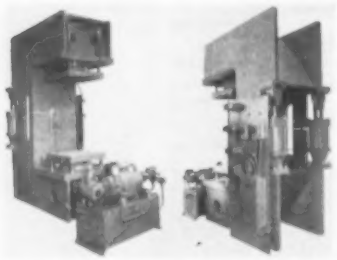
I am interested in (*state application*).....

.....

## BRIEFS

Critical deflection limits called for a new design to meet requirements of less than .020 in. spread of the *C* at 100 tons force.

This was done by locating hydraulically loaded counteracting cylinders at the back of the *C* to compensate for the pressing



tonnage, so that the reaction load would be in continuous direct relation to the pressing load. The press frame is hinged in its vertical member to provide increased efficiency. The press maintains a pre-determined pressure, and platens are closely synchronized during a major portion of the pressure cycle by means of servo-controls. Tonnage and speed of platen travel is fully adjustable. ▼▼▼

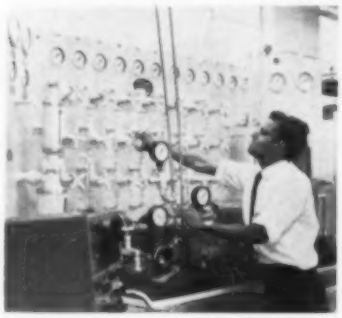
## *Miniature Drill Uses Air Motor*

Miniature drill has a high speed air turbine, floated on air-oil bear-

ings, that will accurately drill holes .001 to .032 in. diameter. The unit has only one moving part and incorporates a ½-in. shank for mounting in standard machine spindles. The air turbine develops speeds from 3500 to 120,000 rpm. A set of needle valves serve as vernier speed throttles, adjustable by the operator without tools. The drill has a pneumatic vertical feed control, adjustable to suit the drill being used. Once adjusted, the amount of pressure applied to the drill is maintained constant, independent of the operator's "feel". A visible feed index always shows the position of the pneumatic downfeed. Milburn Machine Works, Baldwin, N. Y. ▼▼▼

## *Racine Hydraulics Expands Facilities, Product Lines*

New R & D facilities occupying 8,000 sq ft, and manufacturing-



testing space covering over 40,000 sq ft are being completed at Racine Hydraulics & Machinery, Inc., Racine, Wisc. Equipment includes a new test analyzer (see photo) patterned after a telephone switchboard, which will permit simultaneous, multiple circuit testing. This testing machine was designed and built by Racine Hydraulics engineers and will greatly speed-up hydraulic testing and controls programs.

Because of its rapid growth, the Mobile Division will have its own development, production, and sales facilities.

In addition to its physical expansion program, the company has completed cross-licensing arrangements with Vickers-Armstrong (Engineers) Ltd., of Great Britain, which enables Racine Hydraulics to offer a complete line of large hydraulic equipment. Racine

Continued on page 32

New multi-purpose *Rex-Syn* offers manufacturers of original equipment a unique combination of economy and efficiency in moulded cup packings.

After more than two years of extensive laboratory and field testing, Rex-Syn (plastic-rubber) packings are proving ideal for actuating equipment where pressures are medium to high—where pH extremes must be considered—where long storage life is important—and where low first cost is a definite factor.

Other important Rex-Syn features: extremely low friction rating—"equal to the best on the market"; a wide temperature range (0° F. to 212° F.); high resistance to abrasion (outlasts other elastomers 2 to 1); high tensile strength (rated at 3200 psi.); compatibility with a variety of media—air, oil, acid and alkaline solutions and water base hydraulic fluids.

Rex-Syn packings are available in all standard cup sizes from 1″ through 6″ O.D. For a copy of the informative Rex-Syn folder write E. F. Houghton & Co., 303 W. Lehigh Avenue, Philadelphia 33, Pa.

Industry's Partner in Production

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HOUGHTON
THE ONLY COMPLETE LINE OF
PACKINGS & FLUIDS
FOR INDUSTRIAL HYDRAULIC SYSTEMS

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These RMC thermometers have just been submerged in water for the first of a severe series of tests to make sure of perfect hermetic sealing.

# Moisture will never bother your RMC dial thermometer

The RMC hermetic sealing process makes absolutely certain that humid air will not be sealed in the instrument and locks all moisture out permanently. Each thermometer then goes through a series of severe tests. Only those with perfect sealing are accepted for delivery. When you order from RMC you get the *only* industrial thermometer that can *never* be affected by internal dial fogging or bimetal freeze-up.

## "Bimetal Freeze-up" More Serious Than Dial Fogging

The first sign of moisture in a dial thermometer usually shows up as condensation inside the dial glass. You are probably familiar with this dial fogging problem which causes difficult reading and the eventual corrosion of the bimetallic element. You may not, however, be familiar with another and actually more serious moisture problem—bimetal "freeze-up."

If moisture is sealed in, or enters a thermometer dial it will find its way to the bimetal element. Then at extreme low temperatures this moisture freezes on the element and bearing surfaces, and the bimetal element will not function should the temperature go lower. Therefore, the operator of the equipment would never know that the temperature had gone below the last indication when the element became frozen.

Here's what makes such a condition hard to spot. The thermometer would operate properly again after a temperature rise of perhaps 20°, and would continue accurate indication even though the fluid dropped again to an even lower temperature than before. However, after it remained at the new low for a few hours, it would again freeze up. Then, as before, any further drop in temperature would not be indicated.

Only a dry-air hermetic seal, as used by RMC, can prevent both dial fogging and bimetal freeze-up. RMC even goes a step further by providing for recalibration at any time without breaking the air-tight seal. An external dial reset screw—exclusive with RMC—permits recalibration without opening the instrument in any way.

Write, wire or phone for general catalog. If yours is a special application, tell us your requirements—RMC engineers will work with you in solving it. Rochester Manufacturing Co., 209 Rockwood St., Rochester 10, N. Y. (Telephone: BRowning 1-2020).

RMC

ROCHESTER MANUFACTURING CO., INC.
209 ROCKWOOD STREET • ROCHESTER 10, N.Y.

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

REPRESENTATIVES IN ALL PRINCIPAL CITIES

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## BRIEFS

Hydraulics has also acquired a new subsidiary—Sarasota Precision Products, Inc., Sarasota, Fla., makers of miniature aluminum valves and hydraulic components. The company will supply hydraulic components to the mobile, construction and agricultural industries. It will also supply special equipment to meet some medical and dental needs. ▼▼▼

## *Numerical Control System Subsitutes Pneumatics for Electronics*

A new concept in automation, in which hydraulics and pneumatics replace electronics, has been developed by Moog Servocontrols, Inc., E. Aurora, New York.

The Moog numerical control system consists of a combination tape-reader and control console,

compressed air storage compartment, and a hydraulic cylinder unit beneath the machine table. A punched tape is placed in the machine tool tape reader. The punched holes actuate air pressures which are directed upon a metal, diaphragm-type transducer. The diaphragm converts pneumatic pressures into hydraulic power which actuates a series of hydraulic servo controlled cylinders. The cylinders accurately position the machine table on two axes for any point-to-point metal working operations. Repeatability is ±.0003", and table position tolerance is ±.0005". Durability, ease, and economy of maintenance are important advantages. The

Continued on page 34

*NEW...*
**AND AVAILABLE**

•

# "LUBRI-AIR®"

***FILTER, AND LUBRICATOR***

# METAL BOWL UNITS

•

***VISIBLE OIL LEVEL***

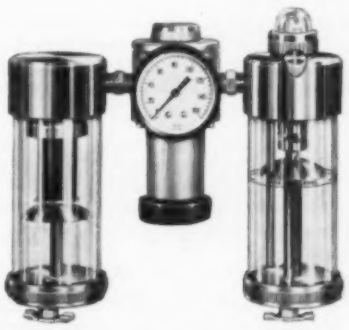
***VISIBLE OIL FLOW***

•

## INTERCHANGEABLE

**with "Lubri-Air" plastic bowl units**

Pat. Applied For



New metal bowl "Lubri-Air"® Filters and Lubricators are obtainable in ¼" and ⅜" port sizes, with immediate delivery. Other sizes will follow. Conversion units for ¼" and ⅜" plastic bowl "Lubri-Air" units are also available. Write for Sales Manual LA-20M . . . Dept. AH-1160, Bellows-Valvair, Akron 9, Ohio . . . or, call your Bellows-Valvair Field Engineer.

Without losing the feature of "VISIBILITY OF CONTENTS" which gives plastic Filter and Lubricator bowls a universal appeal, the new Sight Glass-Metal Bowl units offered by Bellows-Valvair eliminate the hazards caused when plastic containers break down from chemical action. "Lubri-Air" aluminum Filter and Lubricator units may be used for higher pressure, higher temperature applications than plastic bowls; they are not affected when fire-resistant oils are used in compressor or lubricating systems. The sight glass has wide angle visibility for easy level reading . . . Lubricators (unit shown above) have a tempered Pyrex glass dome for quick determination of oil flow.

917C

Bellows-Valvair

**Bellows-Valvair**

AKRON 9, OHIO

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

NEW
**Rubbernek**
FLARELESS
**FITTING**

**ABSORBS**
**VIBRATION**

***Unique Construction!***

Rubbernek absorbs vibration, pulsating pressure surges. Hydrostatic tests prove Rubbernek's seal-tight qualities are maintained at high pressures... withstand test conditions far more severe than those normally encountered in actual service. The cushion unit, comprising five special parts — seal, anchor, guide, retainer and cushion, prevents metal to metal contact of tube and connector.

Rubbernek is factory assembled and gives perfect, foolproof, time-saving installations every time. Rubbernek's special design eliminates torque problems. No flaring or other tube preparation necessary.

**Rubbernek**
conforms to J. I. C. standards. Can be reconnected repeatedly. Exceeds MIL-F-5506-A requirements.

*Chicago Forging invites you to test Rubbernek.*

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**& MANUFACTURING CO.**
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CHICAGO 14, ILLINOIS

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## BRIEFS

sealed system is less sensitive to dust. Maintenance men do not require special schooling to service the machines.

Greatest benefits of this system are greatly reduced initial cost and the machine's ability to match the precision of electronically actuated numerical control systems. The Moog system equals electronic precision, without the danger of developing gradual inaccuracies due to part wear. ▼▼▼

## *Hydraulic Cylinder Has No Seals*

Machine for advanced cycling or fatigue testing of materials has low friction cylinder which uses no rings or packing glands. The cylinder is designed for high frequency stroking. Sealing is accomplished by viscous techniques with separate leakage return lines to reservoir. The cylinder is double ended and rated for 50,000-lb nominal force output at 2000-psi differential pressure.

Continued on page 38

## BRIEF NOTES

***NFPA SPECIAL COMMITTEE*** . . . met with representatives of the U. S. Department of Commerce, the Bureau of the Budget, and the Bureau of Census to discuss the possibilities of obtaining a SIC number for the fluid power industry. The special committee is currently surveying hydraulic and pneumatic component manufacturers to review the committee's recommended fluid power definitions.

***ROTARY SOLENOIDS*** . . . actuate hydraulic spool valves in a new line shown by Rivett Inc., Boston, Mass. at the Machine Tool Show. Compared to linear solenoid-operated valves, the new valves have faster actuation speeds, and save considerable space. Because of lower in-rush current, they permit lower cost components in the electrical control circuit. Four-way, 3-position valves have been on test for over 20 million cycles.

***CUSTOM COMPONENT SWITCHES, INC.*** . . . Burbank, Calif., has created an industrial sales division to market a recently introduced line of pressure switches for general industry. The switch is the first industrial type to use a negative rate, Belleville spring.

***SHENANGO FURNACE PLANT EXPANSION*** . . . totalling nearly half a million dollars was recently completed at the Centrifugally Cast Products Div., Dover, Ohio. Equipment addition and relocation will improve handling, production and finishing of both ferrous and nonferrous centrifugal castings.

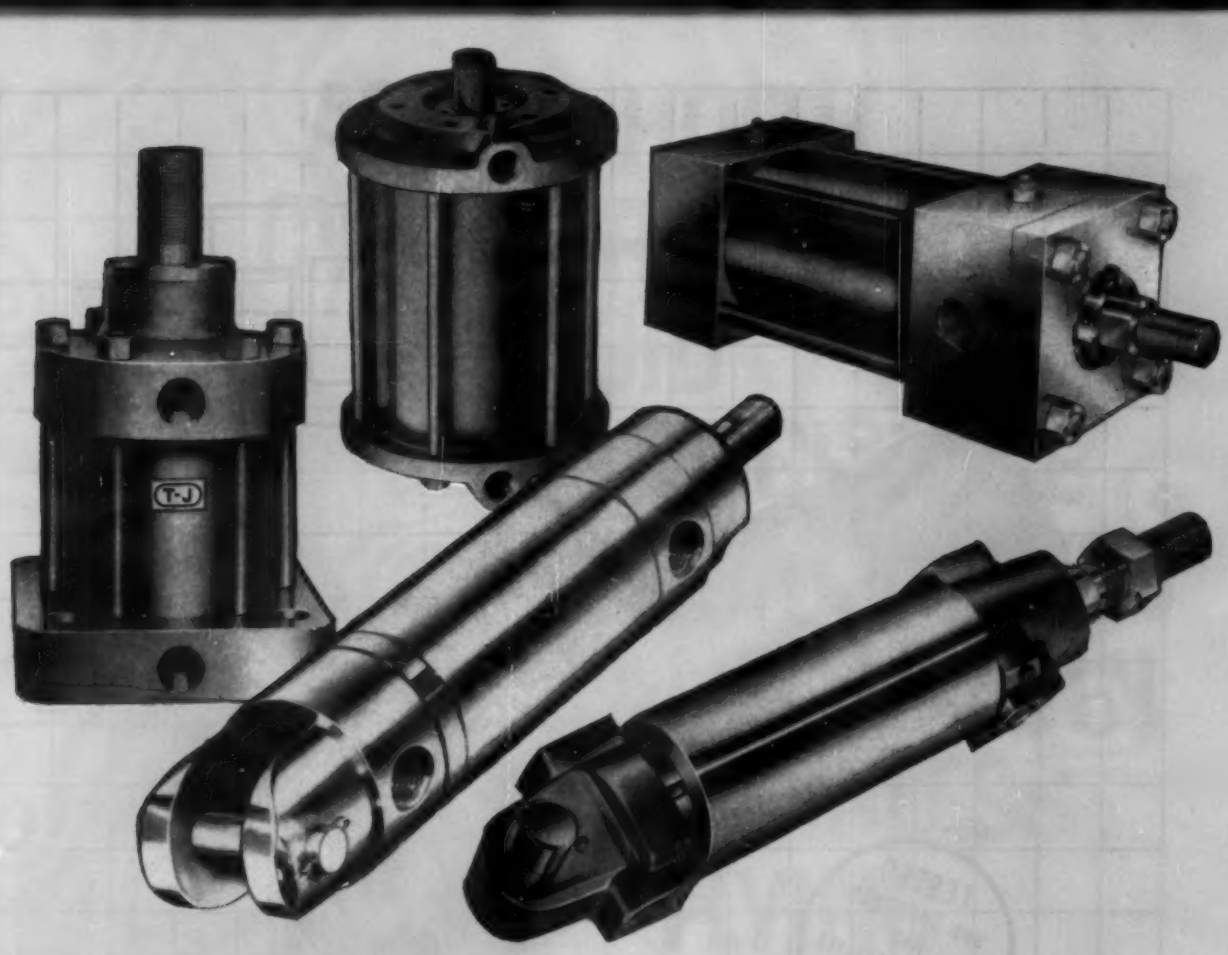
***TEFLON HOSE FITTING LICENSE*** . . . to manufacture and sell Resistoflex circumferentially swaged fittings for Teflon hose and hose assemblies in the U. S., was granted to Titeflex, Inc., Springfield, Mass. The company was also granted an option to produce, under license, other Resistoflex proprietary products.

***PLASTIC NETTING & PIPING*** . . . are manufactured in one operation which extrudes polymers in tubular net form. Each strand intersection is stronger than the strands. Applications include protective sleeves over highly polished tubular machine parts, and center tubes in cylindrical liquid filter cores. Material is *Vexar* made by du Pont.

***MINIATURE VALVES*** . . . New entry in the field of small, 2, 3, and 4-way solenoid valves was made by Vickers, Inc., Detroit, Mich., at the Production Engineering Show. The valves handle up to 2 gpm at 2000 psi. The 4-way valve measures 2.22″ x .162″. Single solenoid model is 4.39″ long; double solenoid, is 5.83″ long. The valve body is square to allow panel mounting.



Circle **144** →




**For Your Power Drive • Design • Application or Replacement Maintenance**

# There's a T-J CYLINDER

## That Can Assure *Accurate Efficient Operation*

Only T-J's complete line can assure you a cylinder of either air or hydraulic application – with practically limitless design specifications for bore, stroke, pressure range and even delivery requirement. From the time-tested, standard tie-rod air and hydraulic, to the exclusive T-J Spacemaker, and including the recently introduced Squair Head, T-J cylinders give you more features for efficient, long-lasting operation. Write today!

*Plus*

**THE ONLY COMPLETE ENGINEERING CATALOG LINE, TOO!**

**H-47** for standard tie-rod hydraulic cylinders.

**SQ-1058-4** for the T-J Squair Head cylinder.

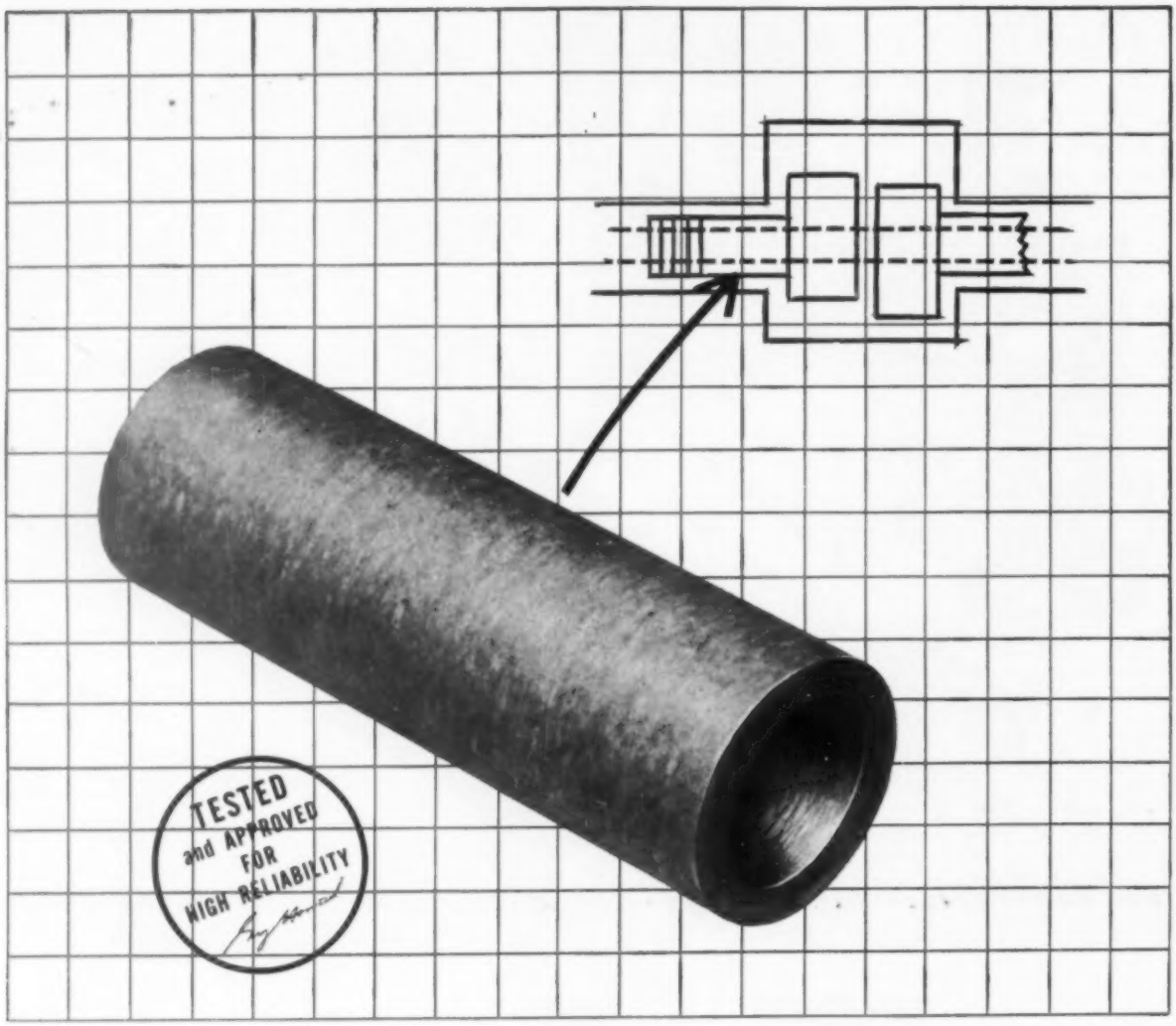
**No. 54** for standard tie-rod air cylinders.

**SM-56-3** for the incomparable Spacemaker cylinder.

**HSM5-58-4** for the High-Pressure Hydraulic Spacemaker cylinder.

## THE TOMKINS • JOHNSON CO. JACKSON, MICH.

**CYLINDERS • MILLING CUTTERS • RIVETERS and CLINCHERS**




# R/M CAPABILITY *produces*

## *reinforced Teflon* bearings*

**• to lower friction • to resist extrusion • to resist corrosion • to eliminate contaminating lubricants**

**R/M reinforced Teflon bearings** are giving excellent service in a wide variety of industries. In the chemical industry, their use has greatly extended the range of chemicals that can be handled by a single pump — and lengthened the life of shafts in acid pumps. In the textile and food industries, they have eliminated the need for lubricants and the resulting contamination of materials in process. And in almost every application, they have lowered replacement costs and maintenance requirements while reducing wear.

R/M reinforced Teflon bearings can be machined to very close tolerance. The high rate of thermal expansion and poor cold flow characteristics of pure "Teflon" have been greatly reduced with this reinforced material.

If you have a bearing application, particularly where corrosion and high temperatures present a problem, or where normal lubricants cannot be used, R/M reinforced "Teflon" bearings may be the answer. Send data on your application.

*Registered trademark for Du Pont fluorocarbon resins

**R/M PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

# ANKER-HOLTH CYLINDERS FULFILL RIGID WESTINGHOUSE REQUIREMENTS IN NEW WEAN GEARLESS 'FLYING PRESS'

A new gearless "Flying Press", especially designed and built by Wean Equipment Corporation for Westinghouse Electric Corporation's Standard Control Division at Beaver, Pa., is equipped with Anker-Holth cylinders.

The press operates at twice the production rate of the presses previously used for this operation. It offers reduced die maintenance and permits simplified over-all machine maintenance.

Necessary components in the press are rugged, reliable cylinders for pulling the lower bed out of alignment in event of cobble or mis-feed emergencies. Wean has found that Anker-Holth cylinders fulfill this rigid and exacting requirement.

Chances are, Anker-Holth has the answer to your power cylinder needs, too. You may choose from the world's widest selection of standard models, available in all mountings. Special cylinders can be designed to your exact requirements, usually assembled from a combination of standard parts.

**YOU HAVE A BETTER CHANCE OF FINDING THE EXACT POWER CYLINDER YOU NEED IN A STANDARD PRODUCTION MODEL AT ANKER-HOLTH**

**ANKER HOLTH**

**DIVISION, THE McDOWELL-WELLMAN COMPANIES**
**2723 CONNOR STREET, PORT HURON, MICH., U.S.A.**



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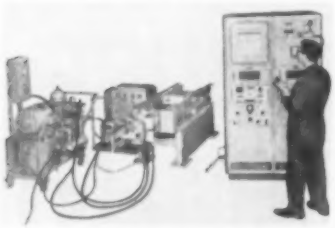
## BRIEFS

The unit is electrohydraulic with individual closed loop systems for force and heat loading. The 4-way electrohydraulic servovalve is rated



at 10-gpm nominal peak flow with a total pressure drop of 1000 psi. This allows a piston speed of 1-in. per sec with a hydraulic pump rating of 6 gpm maximum at 3000 psi output pressure.

For safety, flame-resistant hydraulic fluid is used in the system. Manufactured by Compu-Dyne Corp., Hatboro, Pa. ▼▼▼

More Briefs on page 40

### BUSINESS BRIEFS

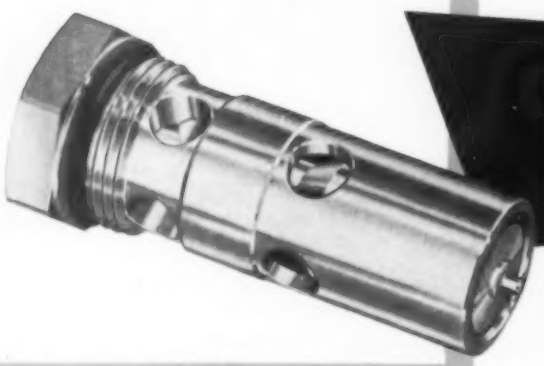
***WESTINGHOUSE AIR BRAKE CO.*** . . . announced the purchase of assets and business of Petch Manufacturing Co., and Petch Industries, Inc., Alpena, Mich. The Michigan firms, manufacturers of pneumatic and hydraulic cylinders, fluid power control panels, and aircraft flight controls, will be operated by the Industrial Products division of Wabco.

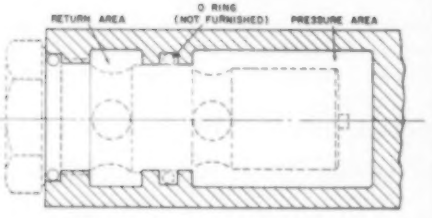
***PUROLATOR PRODUCTS RECORDS PEAK MONTHS*** . . . for original equipment orders. President James D. Abeles, announced that his company had received more than $3.2 million in orders for the months of May and June. This represents an increase of approximately $1 million over the same period in 1959.

***WALTER KIDDE SALES INCREASE*** . . . in the first six months of 1960 did not offset higher costs. Net income per share declined from $.83 in 1959 to $.21. Sales for the balance of the year are expected to remain at approximately the same level as for the first six months.

***PARKER-HANNIFIN*** . . . earnings hit a new high for the 4th consecutive year ended June 30th, 1960. Net earnings were $2,873,537 equal to $2.20 per share. This compares with corresponding 1959 net earnings of $2,464,916 equal to $1.90 per share.

***BORG-WARNER CORPORATION*** . . . parent company of Pesco Products and Wooster Divisions, reported net sales for the first six months of 1960 at $323,068,651 compared to last year's $327,803,597 for a similar period. Earnings dipped from $2.04 to $1.68 per common share.




Fawick Cartridge Relief Valve plugs into any housing, such as multiple section valve block, which has pump pressure and provision for return to pump. O-ring seal separates pressure and return areas.

***control fluid flow better***

*with . . .*

**FAWICK**
**CARTRIDGE RELIEF**
**VALVES**

- 30 gpm rated capacity
- plugs directly into control circuit
- exclusive pin-and-hole orifice assures instant response to surge pressures, provides self-cleaning action
- fail-safe against excessive dirt, protects hydraulic system at all times
- less than 50 psi differential from trickle to full flow
- less than 25 psi differential between cracking and closing
- no leakage below cracking pressure
- no internal leakage

**For more information on Fawick flow control products, write:**

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FLOW DIVIDER VALVES • INLET VALVES • CARTRIDGE RELIEF VALVES • SERVO VALVES • TWO SELECTOR VALVES • FUEL PUMPS • LUBE OIL PUMPS • FLOW REGULATOR VALVES • GEAR HYDRAULIC STEERING SYSTEMS




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Circle 139 →

*Hydraulic Power System Ideas . . . from* **SUNDSTRAND**

Sundstrand test combine powered by new closed-circuit hydrostatic propulsion system. Drive has also been applied to industrial mobile equipment.

# START . . . STOP . . . REVERSE . . . Change speed with a single lever

The Sundstrand hydrostatic transmission offers many operational advantages to the heavy machinery manufacturer and user, including single lever control for speed and direction, infinitely variable speed range, dynamic braking, and constant propelling speed regardless of load (torque varies automatically). Application possibilities for this versatile system are almost endless.

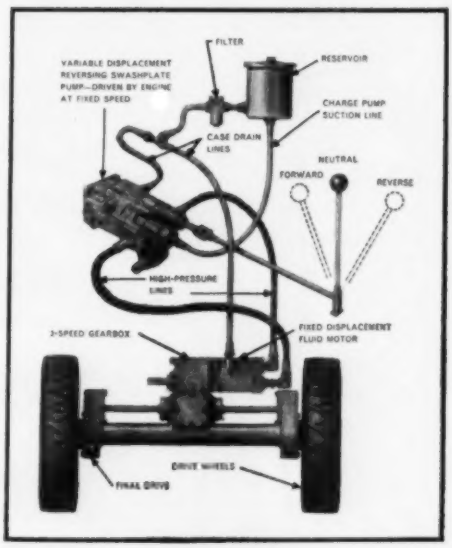
**THE SYSTEM** is comprised of a reversing swashplate, variable displacement pump, a fixed displacement motor, and an oil reservoir. On the farm combine shown above the pump is driven by the combine engine and requires no separate power source. The fixed displacement motor drives through a three-speed gearbox (emergency, working, transport) to differential and wheels.

**HOW IT WORKS.** The function of the variable displacement pump is to convert the constant output speed of the combine engine to infinitely variable power at the wheels. This is accomplished by the reversing swashplate in the pump. The position of the plate determines the quantity and direction of oil going to the fixed displacement motor. The swashplate is controlled by a single lever beside the operator.

Once control lever is set for a certain drive speed, the hydrostatic transmission will maintain that speed regardless of load. On the combine this assures ground speed matched to thresher load . . . permitting the operator to devote more time to other operations.

**LEVER CONTROLS BRAKING.** To slow or stop the wheels, the operator simply moves the control lever toward neutral. Reduction in driving angle of swashplate retards oil flow to fixed displacement motor, slowing the wheels. Dynamic braking helps simplify equipment design by eliminating all other braking systems except those needed for parking.

The new Sundstrand hydrostatic propulsion system described can be applied to a wide variety of equipment now using mechanical transmission systems. For quantity installations the system also compares favorably with mechanical systems on a unit cost basis.




If you would like more information about the many application possibilities of Sundstrand hydraulic components and systems, write outlining your requirements to:

Mr. Ray Murphy, *Application Engineer*

**SUNDSTRAND HYDRAULICS**
DIVISION OF SUNDSTRAND CORPORATION
2210 Harrison Avenue • Rockford, Illinois

FOR MOBILE EQUIPMENT
FOR MATERIALS HANDLING SYSTEMS
FOR MISSILES, ROCKET LAUNCHERS AND AIRCRAFT
RACINE
HYDRAULIC COMPONENTS
The heart of BETTER MACHINERY
Racine hydraulic pumps, valves, controls and pressure boosters are available for application in practically every hydraulically operated circuit . . . be it in use or in the design stage . . . whether on equipment being manufactured or equipment used in manufacturing. For the most versatile, the most stout-hearted hydraulic components, RACINE is a popular choice with industry everywhere.
FOR METALWORKING MACHINERY AND TRANSFER EQUIPMENT
FOR FARM EQUIPMENT
FOR PRINTING, PAPER PROCESSING, WOODWORKING AND OTHER SPECIAL INDUSTRY MACHINES
FOR RAILROAD EQUIPMENT

RACINE

**Racine Hydraulics & Machinery, Inc.**

RACINE, WISCONSIN

HYDRAULICS DIVISION

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## BRIEFS

### Glossary of Fluid Power Terms

The National Fluid Power Association recently published the second edition of its glossary of fluid power terms. This edition is the second step in the preparation of a comprehensive glossary of terms and definitions for fluid power. It lists and describes technical terms used in the fluid power industry and provides manufacturers, users, educators, technicians, and beginners with a unified manual. It will simplify technical communication and reduce interpretation errors. W. J. Kudlaty, Miller Fluid Power Div., is chairman of the NFPA Terminology Committee which prepared the glossary. It is available at a nominal charge from NFPA headquarters, 5595 N. Hollywood Ave., Milwaukee 17, Wis. ▼▼▼

. . . so then we changed to a pneumatic system!!

### ASME Fluid Power Group to Meet

The Fluid Power Systems Division of the American Society of Mechanical Engineers, Philadelphia section, will hold its first meeting of the 1960-61 season on November 15, at the Engineers Club, 1317 Spruce Street, Philadelphia.

Guest speaker will be Howard F. Brinen, vice-president, Young Radiator Co., Racine, Wisc. Mr. Brinen will discuss "Forced Heat Dissipation from Fluid Power Circuits". His illustrated talk will cover the series heat transfer analogy including film factors, selection and rating of exchangers, and a discussion of fouling factors and their application. ▼▼▼

## Hydraulic Shifting Puts Tractor in Forward and Reverse

A steering column mounted lever, hydraulically controls forward and reverse movement of the tractor without stopping the machine to clutch or shift gears. It engages one of two multiple disc clutches, one for forward travel, the other for reverse. The hydraulic system is fully enclosed and the oil is triple-filtered with full-flow micronic, magnetic, and wire mesh filters.

The machine is also equipped with a pneumatic coupling which provides a flexible, vibration-free

connection between the engine flywheel and the torque converter. The four-wheel drive loader has a carrying capacity of 4,000 lb and a static lifting capacity of 9,500 lb. Manufacturer is Allis-Chalmers Mfg. Co., Milwaukee, Wis. ▼▼▼

## Vickers Holds Servo School

Twenty-four men representing aircraft manufacturers, research organizations, government agencies, and publications were guests of Vickers Inc., Detroit, in Sep-

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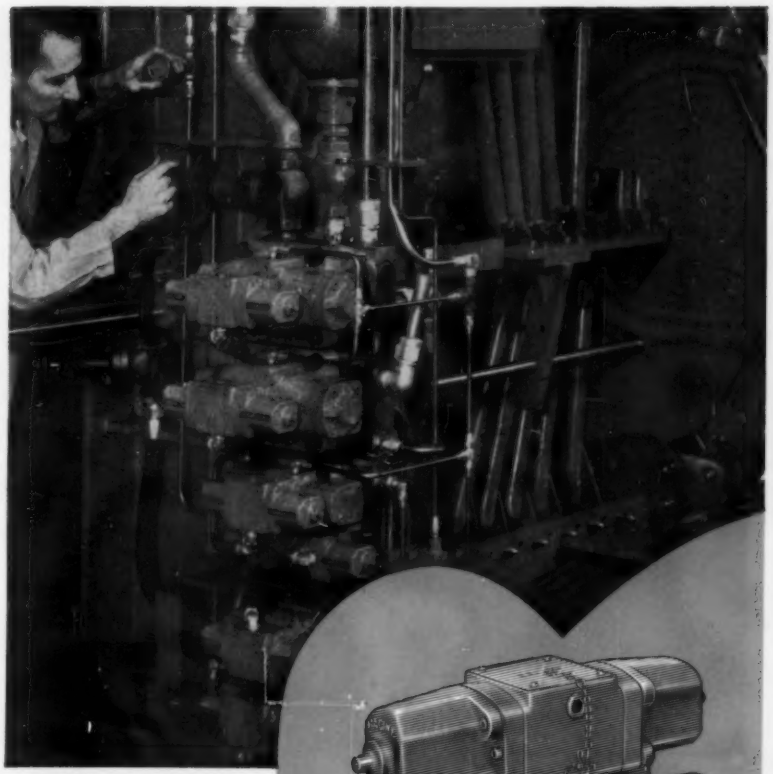


HYDRAULIC VALVE SYSTEM OF WIRE-FORMING MACHINE BUILT BY RESEARCH DESIGNING SERVICE, INC., CENTERLINE, MICHIGAN

during set-up and at 3000 springs per hour

RELIABLE VALVES DIRECT THE POWER OF A HYDRAULIC HEART

"Control of all our hydraulic operations is vital, and this is possible with RACINE equipment," says Bill Karolle, electrical engineer with Research Designing Service, Inc. "Our hydraulic machines are used to form wire for 80% of all automobile seat springs." As oil requirements change constantly during set-up operations, 6 RACINE DIRECTIONAL CONTROL VALVES guide the *right oil volume* at the *right pressure* to the *right place* at the *right time*. At high production speeds, these 4-way, solenoid-controlled valves maintain the pre-set wire forming pattern with absolutely uniform precision. Valve reliability is important since these machines may perform over five million cycles during their lifetime.

6 RACINE

*Directional Control Valves guide hydraulic wire-forming operations of this machine*

RACINE

Racine Hydraulics & Machinery, Inc.

RACINE, WISCONSIN

HYDRAULICS DIVISION

Circle **121** on **Time-Saver** Card

SELF-CONTAINED J.I.C. POWER UNITS SERVING UNIVERSAL SPIDER TRANSFER MACHINE BUILT BY DRILLUNIT, INC., DETROIT

# Six hydraulic hearts

**FURNISH MUSCLE FOR 5 TRANSFER OPERATIONS . . . WITHOUT A PALLET**

"This is the first time that a spider for a universal joint has been machined in direct transfer of the part itself rather than by pallet transfer," says William Dehbaugh, Vice President and Chief Engineer of Drillunit, Inc. The new unit is only half the size of any previous spider transfer machine. Clamping and unclamping the spider are governed by 5 RACINE Model 4FA Pumps, each one a self-contained power unit with its own reservoir. A sixth 4FA unit controls movements which turn, probe and transfer the part from station to station. To complete the hydraulic package, 24 RACINE Model Q Pumps serve the standard self-contained drill units. R. S. Naeyaert, President, adds, "RACINE flexibility in delivering pressurized oil in *variable volume* at *varying pressures* make it the ideal choice."

*The HEARTS of this automotive transfer operation are the compact* RACINE *Power Units equipped with*

MODEL 4FA
VARIABLE VOLUME
VANE-TYPE PUMPS

RACINE

**Racine Hydraulics & Machinery, Inc.**
RACINE, WISCONSIN
HYDRAULICS DIVISION

Circle **122** on Time-Saver Card


## BRIEFS

tember for a one-week course on servomechanisms. Instructors from Vickers' Aero Hydraulics Div. covered basic servo theory, components for servo systems, and system design and application.

One session was devoted to a discussion of types and solutions of differential equations, stability criteria, and frequency and transient response. Following classes discussed types of servovalves and defined terms to describe their performance. Servo pump and servovalve systems were described. Requirements of fluids, filters, and seals was the subject of one session. Another was devoted to design and applications of hot gas systems. Analog computer techniques in servo analysis was the topic for the closing meeting. ▼▼▼

## *Use of Fire-Resistant Fluids Increasing*

Steady increase in the use of fire-resistant fluids is reported in a survey made by PRECISION METAL MOLDING Magazine. Of the 445 die-casting shops that cooperated in this survey, over 59% reported using some type of fire-resistant hydraulic fluid.

FIRE-RESISTANT FLUIDS IN DIE CASTING SHOPS

| | Job Shops | Captive Shops | Job & Captive Shops |
|---|---|---|---|
| No. Plants Surveyed | 233 | 92 | 120 |
| No. Using F-R Fluid | 141 | 59 | 64 |
| Average Annual Consumption—gal. | 606 | 3700 | 564 |

This trend is further reflected in sales figures. Sales of fire-resistant fluids has jumped from 512,000 gallons in 1954 to 1,807,000 gallons in 1959. 1,058,000 gallons were sold in the first six months of 1960. These sales figures were furnished by seven producers of fire-resistant fluids.

Three years ago, the average die-casting shop estimated that

downtime per machine cost $35.00 to $55.00 an hour. These costs have since gone up.

The increased availability of good packings and seals have cut leakage so that the amount of make-up fluid required is now minimized. Intial cost for the fire-resistant fluid on either new equipment or on change-over is still high, but it is relatively small compared to the losses a plant may sustain from even a small fire.

While none of the fire insurance underwriters are now granting a lower rate to f-r fluid users, one well known company is studying this problem and will probably recommend a lower rate to companies using an approved fire-resistant fluid. ▼▼▼

## Nylon Hose Gives Strength & Safety

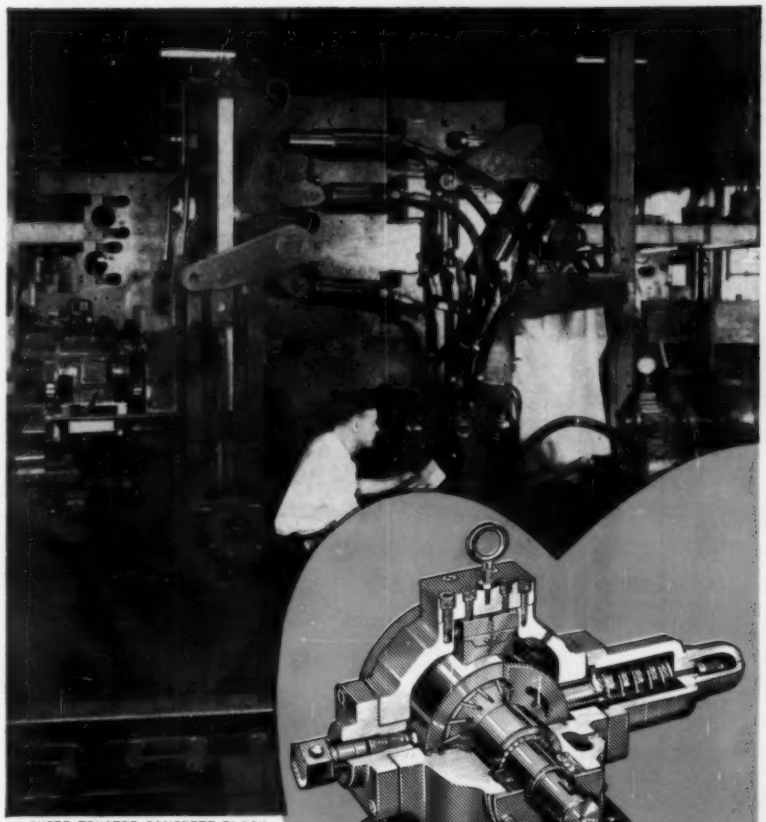
High hydraulic pressures and insulation against high voltage electrical charges were two problems facing the Asplundh Chipper

**HYDRAULICALLY CONTROLLED BOOM** of this utility truck uses nylon hose and tube. The lines need good insulating properties when the boom accidentally contacts a high voltage line.

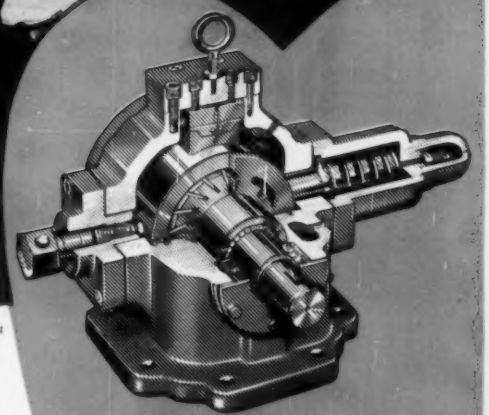
Co., manufacturers of utility maintenance trucks.

A ¼"-ID hose in the boom required a burst pressure of 8000 psi and good insulating properties. They met these requirements with

Continued on page 45

SUPER TRUSTEE CONCRETE BLOCK MACHINE BUILT BY THE GENE OLSEN CORP., ADRIAN, MICHIGAN



*The heart of this 1100 blocks per hour concrete block machine is a*
RACINE
MODEL 8R PUMP

# This dependable hydraulic heart

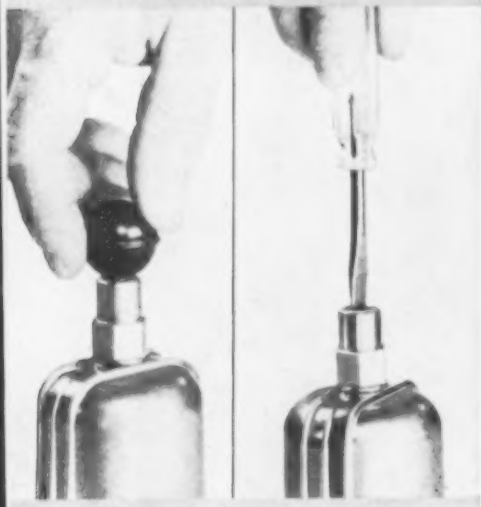
REDUCES UPKEEP AND DOWN-TIME BY AS MUCH AS 80%

"RACINE HYDRAULIC EQUIPMENT is the *heart* of our concrete block machines," says C. S. DeLamater, sales manager for The Gene Olsen Corp., another satisfied user of RACINE PUMPS and VALVES exclusively since 1949. Besides the tremendous savings in operating hydraulically-designed concrete block machinery, the firm emphasizes the advantage of simplified control of oil circulation in RACINE VARIABLE VOLUME PUMPS. They pump *only* the oil required to do the job — no waste of pressure oil — no heating. Thus through lower horsepower, operation economies are enjoyed.

RACINE
**Racine Hydraulics & Machinery, Inc.**
RACINE, WISCONSIN
HYDRAULICS DIVISION

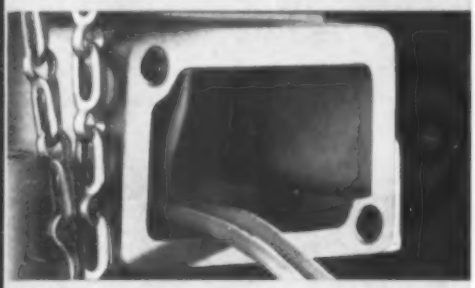
Circle **123** on Time-Saver Card

## NO EXTRA-COST "ACCESSORIES" MAC VALVES ARE COMPLETE



▲ Screwdriver type manual solenoid operators are standard; ball type optional. Both have lock-in feature. Built-in seal keeps dirt and moisture out of solenoid.

▲ Pre-wired electrical plug-in wiring is standard on all MAC solenoid valves. Solenoid plugs in valve body; body plugs into base. Replace valves without changing a wire.



▲ Built-in conduit boxes on both ends of valve bases are interconnected to permit optional conduit installation. Complete with gasket and retainer chain to J.I.C. specs.

MAC VALVES

SERIES 1300
½"—¾"—1"—1¼"

SERIES 300
¼"—⅜"—½"

# TOP PERFORMANCE SMALL SIZE • LOW COST

MAC Series 300 and 1300 air valves are designed around a unique spool-within-a-spool principle that has resulted in a line of valves that industry has found unequalled for performance, compactness and cost.

Performance is outstanding. MAC solenoid-air operated valves work at speeds equal to any known usage—with shorter stroke, direct operation and a highly efficient circular air flow. Tests of 30-, 40-, even 60-million cycles have proved it time and again.

Compactness surpasses performance. For example, the ⅜" port size Model 321 is about the size of just the pilot on most valves of this type. Putting it another way, these valves are about half the size of similar-use competitive valves.

On top of this, cost is far less in single-solenoid models, even lower on double-solenoid valves.

There are other savings, too. Interchangeable valve bodies, bases and solenoids; conversion of single-solenoid models to double-solenoid by simply adding a solenoid cover assembly; only three moving parts; pre-wired electrical plug-in assembly; manifold bases for ganging valves; they all give you added versatility and with fewer parts to stock.

Every MAC valve meets all J.I.C. standards. Every valve is fully tested before it leaves the MAC plant. Ask for Catalog 61 today.

**MECHANICAL AIR CONTROLS, INC.**

10030 CAPITAL, OAK PARK • DETROIT 37, MICHIGAN

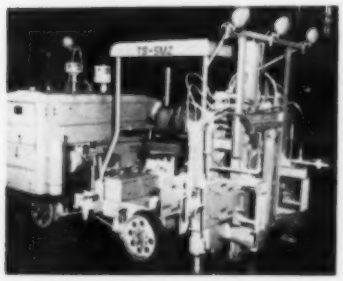
## BRIEFS

nylon hose which provided satisfactory burst pressures and did not break down when subjected to electrical charges as high as 50 kv.

Nylon tubing can be used with standard metal tubing fittings. Hydraulic fluids including fire-resistant types, have had no appreciable effect on nylon hose or tubing. ▼▼▼

### *Air Filters Keep Railroad Equipment Clean*

To increase service life of its maintenance-of-way equipment, the New York Central System has outfitted nearly 3,000 specialized machines and over 400 trucks with



air filters manufactured by Purolator Products, Inc., Rahway, N. J. Illustrated is a spike-driving machine equipped with air filters in the gas engine and air compressor.

One of the major problems that faced the NYC maintenance department was the large variety of filter elements required on their various types of machines. This problem of filter element standardization and replacement was resolved with a dual manifold designed by the maintenance department. All equipment can now be serviced with only three different paper elements. This has greatly simplified maintenance inventory problems. Air filter restriction indicators eliminate element servicing guesswork, because they show when filters need to be changed. ▼▼▼


YOUR DESIGN PROBLEMS NEED

# specialists

BHEW engineers are trained specialists who can save you time and money. BHEW products are noted for their dependable performance, long life and easy maintenance. Next time you have design and application problems, discuss them with BHEW—you'll profit more ways than one!

**BHEW**'s single-acting General Purpose Cylinders (1500 psi Piston Style Series) are designed around standard components but custom-built to suit your application. They're available in a variety of mountings (pin eye is standard) with adjustable or non-adjustable rod ends, with or without rod ends.

DISCUSS YOUR DESIGN AND APPLICATION PROBLEMS WITH US!

WRITE TODAY for free Hydraulic Cylinder Engineering Reference data. 78 dimensional basic designs for general purpose and special double- and single-acting cylinders. SAVE TIME!

BH EW

- Basic Designs
- Specific Adaptations
- Superior Quality
- Application Engineering

**BENTON HARBOR ENGINEERING WORKS, INC.**

622 Langley Avenue • St. Joseph, Michigan

Circle 21 on Time-Saver Card

# DESIGN ESSENTIALS FOR BETTER HYDRAULIC PACKINGS

**THESE BASIC FEATURES** are part of "John Crane" Hydraulic Packings. They assure packings that meet the most rigid requirements of hydraulic service ...a good initial seal, long life, efficient performance over wide pressure ranges and stability in the fluid medium.

**1.** Pressure access allows immediate pressure distribution and packing response.

**2.** Ball joint nesting surfaces facilitate breathing without pinching, wedging or lip collapse.

**3.** Adequate lubrication reservoir.

**4.** Uniform bottom thickness eliminates weak points and insures centerline hinge action.

**5.** Molded-in lip interference insures tight static seal and conformation to bore and rod deflections.

**6.** Heel clearance prevents "riding" at heel and eliminates lip toe-in.

**7.** The fabric in the "V" rings is so laid to assure maximum strength—an important consideration for maximum packing life.

Tell us about your standard requirements and ask for recommendations and/or assistance in the creation of a combination of packings that will best handle individual operating conditions. Request Bulletin P-333 for general information.

Crane Packing Company, 6405 Oakton Street, Morton Grove, Ill. (Chicago Suburb).

*In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

John Crane

MECHANICAL PACKINGS · SHAFT SEALS · TEFLON PRODUCTS · LAPPING MACHINES · THREAD COMPOUNDS

CRANE PACKING COMPANY

Circle **37** on Time-Saver Card


# FUTURE EVENTS

**IST NATIONAL DIE CASTING EXPOSITION & CONGRESS**

November 8-11

Detroit Artillery Armory

**ASTME WESTERN TOOL SHOW**

November 14-18

Los Angeles Sports Arena

**MEETING, ASME FLUID POWER SYSTEMS DIV., PHILADELPHIA SECTION**

November 15

Engineers Club
Philadelphia

**FLUID CONTROLS INSTITUTE, INC. FALL MEETING**

November 20-22

The Drake, Chicago

**ASME WINTER ANNUAL MEETING**

November 26-December 1

Statler Hilton Hotel
New York

**SEMINAR ON ELECTRO-HYDRAULIC SERVO-SYSTEMS**

December 7

Sponsored by Milwaukee School of Engineering and Milwaukee Chapter, Fluid Power Society
Hall of Science, MSOE, Milwaukee

**SAE INTERNATIONAL CONGRESS & EXPOSITION OF AUTOMOTIVE ENGINEERING**

January 9-13

Cobo Hall, Detroit

**PLANT MAINTENANCE & ENGINEERING SHOW**

January 23-26

International Amphitheatre
Chicago

**NATIONAL FLUID POWER ASSOCIATION SPRING MEETING**

May 14-17

The Greenbrier
White Sulphur Springs, W. Va.

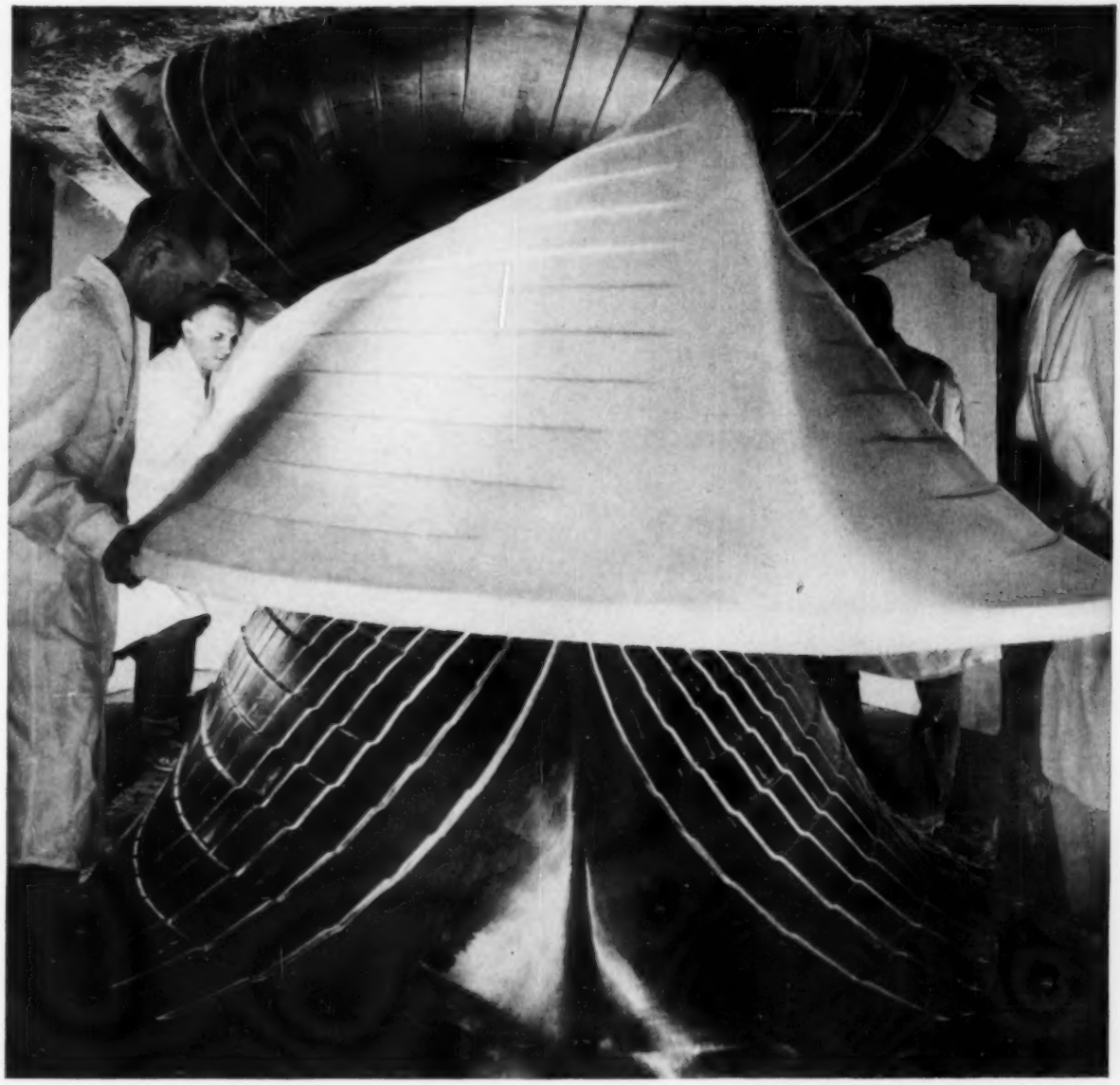


PHOTO COURTESY OF MOLDED FIBER GLASS BOAT CO., UNION CITY, PA.

# Birth of a boat–with the help of Sun Hydraulic Oils

You can take it for granted that today's fiber glass boat hulls, molded in giant hydraulic presses, are leakproof. That's one of their greatest virtues. However, it takes top quality hydraulic oils and service to keep these presses at peak efficiency.

That's why your Sun Representative is a good man to have at your side. Widely experienced in solving hydraulic problems, he can spot the causes of difficulties quickly. He'll analyze your requirements for hydraulic oils . . . and recommend the type best suited to your specific needs.

He can do this because Sun produces a wide range of hydraulic oils to accommodate any system, and to keep it in continuous, trouble-free operation.

In fact, Sun offers dozens of quality products designed for specific applications: oils, greases, waxes, and petrochemicals, just to name a few.

You're certain to find the right petroleum product at Sun to meet your most exacting requirements. Write to Dept. AH-11, SUN OIL COMPANY, Phila. 3, Pa. In Canada: Sun Oil Company Limited, Toronto & Montreal.

SUNOCO

*Quality...*

THE BEST ECONOMY OF ALL

**ORIGINATORS OF FAMOUS CUSTOM-BLENDED BLUE SUNOCO GASOLINES**

# NYLON PRESSURE TUBING

## for Hydraulic-Pneumatic Service

CHEMISEAL Nylon Pressure Tubing can be flexed, twisted or bent into all contours, offers wide design "leeway."

**Flex it . . . twist it . . . bend it! In fact, shape Garlock CHEMISEAL Nylon Pressure Tubing into practically any contour you need.** Think what this means in design freedom and versatility.

**For hydraulic-pneumatic systems,** pressure lubrication lines, oil and fuel lines, vacuum system connections. Garlock CHEMISEAL Nylon Pressure Tubing is a superior design material. It is unaffected by oils, alkalies, hydraulic fluids, and many solvents that tend to corrode metal. It resists vibrational fatigue, abrasion, impact . . . withstands temperatures from −60°F. to +180°F. (can be heat stabilized for 300°F.) . . . available in 1000 and 2500 psi. grades, conforming to J.I.C. specifications. Diameters from ⅛" O.D. up to largest size commercially made, depending on customer needs.

**To guarantee you** best performance possible, CHEMISEAL Nylon Pressure Tubing is subjected to severe tests. For example, the Anvil Impact Test simulates the mechanical abuse that may accidentally occur in service. CHEMISEAL Nylon Pressure Tubing is placed on a flat steel anvil. A 16-pound hammer with a striking head of 6" drops freely onto the tubing from a height of 24". The Roll Bend Test assures freedom from defects which cause flex fatigue. Tubing is passed around and between two grooved rollers to form an "S" shape. Space between rollers is twice the diameter of the tubing. Tubing is then moved back and forth at a rate of at least 125 f.p.m.

**In cost, too,** Garlock CHEMISEAL Nylon Pressure Tubing has the advantage. Seamless copper and extruded aluminum cost approximately four times as much, while welded and seamless stainless steel costs 29 to 37 times more, respectively. Also, the cost of couplings and installation labor should be considered—CHEMISEAL Nylon Pressure Tubing needs no intermediate couplings or fittings . . . is simple to install. You save on first cost, fittings, and labor.

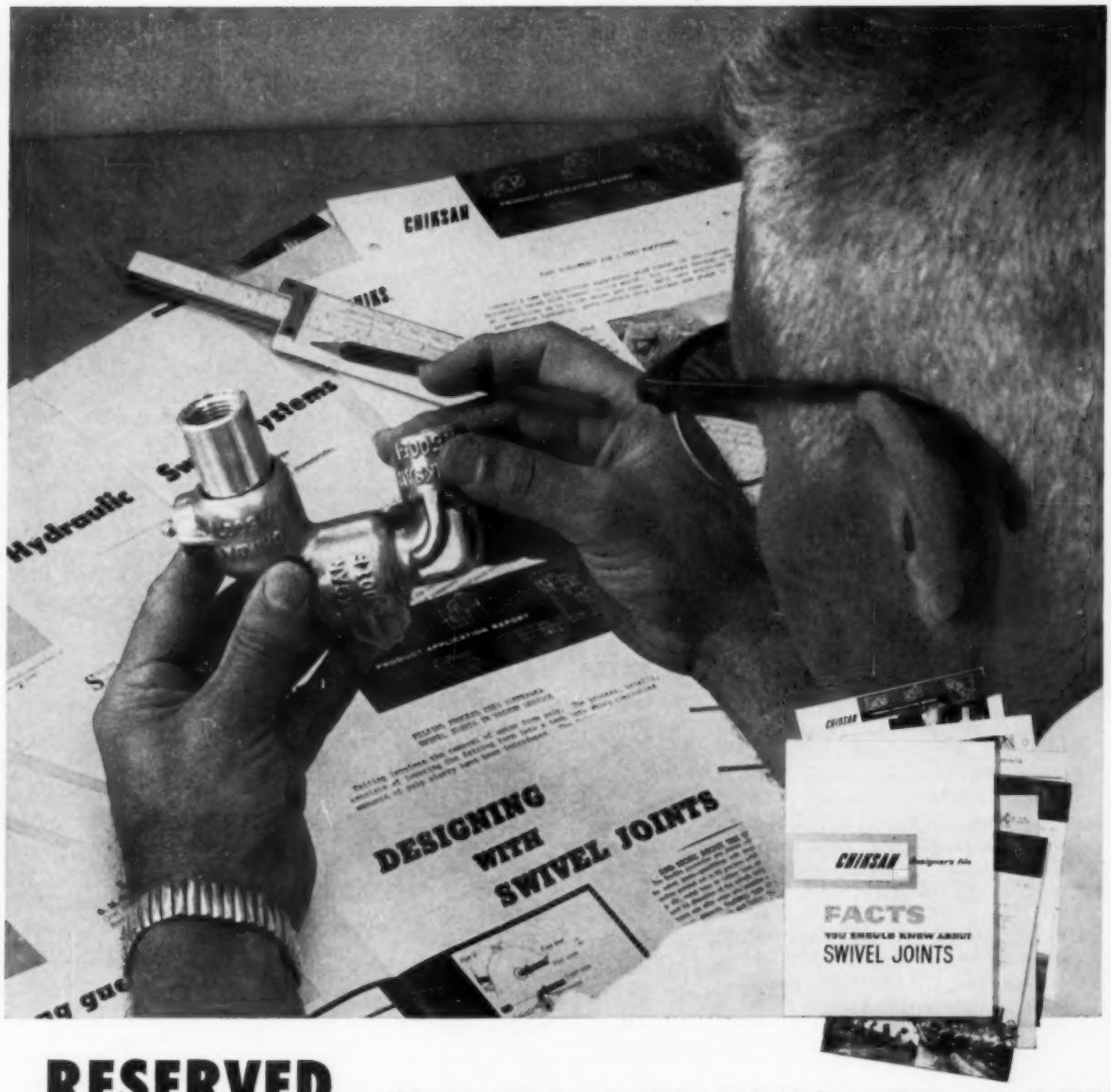
Discover how you can use CHEMISEAL Nylon Pressure Tubing. Call your local Garlock representative at the nearest of the 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-177. Garlock Inc., Palmyra, N. Y.

# GARLOCK

**Canadian Div.:** Garlock of Canada Ltd.

**Plastics Div.:** United States Gasket Company

**Order from the Garlock 2,000 . . .** two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products




# RESERVED

## FOR THE ENGINEER CONCERNED WITH DESIGNING SAFE, DURABLE, FLEXIBLE LINES

*Send for your copy of*
"FACTS YOU SHOULD KNOW ABOUT SWIVEL JOINTS"

**CHIKSAN**

Written by engineers and well illustrated, this file contains a wealth of useful information on the application of swivel joints in line design. You'll find facts and figures on torque, geometric characteristics, thrust and radial loads. There's information on how to approach design problems and a quick comparison between swivel joints and other flexible devices. And, you'll find a group of actual installation reports with diagramatic drawings showing how the swivel joints were applied in the system. Be sure you have a copy of "Facts you should know about Swivel Joints" in your possession. Write Chiksan for your file today.

**CHIKSAN COMPANY, 300 North Brea Blvd., Brea, California**
**Please send me a copy of "Facts you should know about Swivel Joints."**

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CITY_____ STATE_____

#60-53

fmc

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

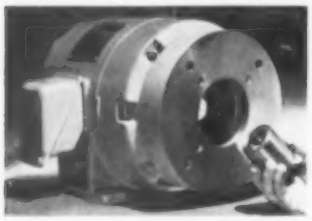
**CHIKSAN COMPANY—Brea, California** • Chicago 5, Ill. • Newark 2, N. J. • Divisions: Chiksan International, Hamer Valves, Weco • Subsidiary: Chiksan of Canada Ltd.

# NEW PRODUCTS

**Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.**

### SPLINE-COUPLED HYDRAULIC PUMP MOTORS

Furnished with coupling. Coupling is splined on motor end, has conventional bore and keyway on pump end. Motor accepts wide



variety of pumps. Pump-mounting face on one end. Dripproof and nonventilated motors available with pump-mounting faces on both ends.

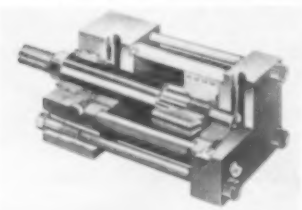
**Specifications:** Almost 3" shorter than General Electric's open-adapter motors. In all ratings now supplied in NEMA frame sizes 182, 184, 213, and 215, nominally 1 to 5 hp, except for explosionproof construction.

**Designation:** Tri-Clad '55'—*Small Integral Motor Dept., General Electric Co., Ft. Wayne, Ind.*

Circle **300** on Time-Saver Card

### HYDRAULIC CYLINDERS

Four types of piston packing. 17 mountings. Interchangeable cylinders meet JIC. Heads, retainers, and mountings are machined steel.



Micro-finished, seamless steel tube. O-rings do not extrude. Piston rods are 110,000-psi steel, hard chrome plated. Teflon rod wipers. Multi-lip rod packing is self-adjusting. Wrench removes rod cartridges. One-piece pistons are of fine-grain-alloy cast iron. They are threaded and pinned to rods. Tapered cushions eliminate cushion adjusting screws.

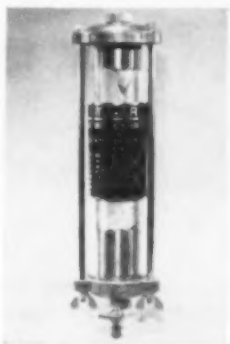
**Specifications:** For 2000-3000 psi. 1½" to 12" bores.

**Designation:** C4H Series—*Sheffer Corp., Cincinnati.*

Circle **301** on Time-Saver Card

### AIR FILTER

Removes all oil vapor. Absorbs moisture and oil vapors. Will divest itself of moisture, but not oil, once it has been absorbed. Element holds 87% of its weight in water; 79% of its weight in oil. Filtering



ingredient packed in nylon cloth bags. Takes up moisture and oil vapors without swelling or increasing in particle size. Negligible loss of efficiency until elements are exhausted. Requires no service or adjustment.

**Specifications:** Capacities from 15 to 150 cfm at 100 psi. Inlet and outlet pipe sizes from ¼" to 2". For 150 and 250 psi. Cylinder diameters from 2" to 4". Lengths from 8" to 25". Filters use one to four elements.

**Designation:** Sta-Dri—*Beach Precision Parts Co., Boonton, N. J.*

Circle **302** on Time-Saver Card

### SHAFT SEAL

Oil-sealing lip is secured and completely enclosed in cartridge. Lip seals within cartridge. Lip does not touch shaft. Cartridge provides sealing surface. Inner sealing member rotates against shell's inner surface. Metal reinforces synthetic-rubber sealing member. Sealing member and shell are a press fit.

Lubricant applied during fabrication stays in place and lubricates sealing lip by centrifugal force. Cartridge requires no special shaft finish or hardness.

**Designation:** C/R Scotseal—*Chicago Rawhide Mfg. Co., Chicago*

Circle **303** on Time-Saver Card

### ACCUMULATORS

Probe seals oil outlet when accumulator is discharged—oil trapped between piston and end cover acts on full piston area minus area covered by port sealing ring. Pressure of trapped oil is greater than that of gas charge. If there is any

leakage, it is of oil into gas. Cannot be disassembled while pressurized.

**Specifications:** Series II is for 0-2000 psi, 8 to 20 gal; Series III, for 5000 psi, 1-8 gal; Series IV, for 5000 psi, 8-20 gal.

**Designation:** Liquid Seal—*Industrial Hydraulics Ltd., Reading, England.*

Circle **304** on Time-Saver Card

**Continued on page 52**

## STANDARD HOSES

| | | |
|---|---|---|
| LOW PRESSURE | H-9 SAE 30R2 | H-100 COTTON COVERED |
| MEDIUM PRESSURE | H-17 SAE 100R3 | |
| HIGH PRESSURE | H-25 SAE 100R2 | |
| MEDIUM HIGH PRESSURE | H-69 SAE 100R5 | |
| MEDIUM HIGH PRESSURE | H-108 SAE 100R1 | |
| HIGH PRESSURE | H-35 | H-50 |

Spiral Wire Reinforced

## REUSABLE ENDS

**STEEL**

**STANDARD 2-PC. END**

For fast assembly and positive, leakproof connections. Designed for dependable performance under high pressure. Skive and no-skive.

**CLAMP-TYPE**

For most two-wire braid high-pressure hydraulic hose applications. No skiving of hose or special tools required.

**BARB-TITE ENDS**

Fast, easy push-on, stay-on hose ends for all types of low pressure applications. Sizes ¼" to ⅜" I.D. Rugged and durable.

## HOSE ASSEMBLIES

**PERMANENTLY ATTACHED HOSE ENDS**

Swaged or crimped permanently attached hose ends. Any quantity, any size, any type. ⅛" to 2". For all working pressures.

CRIMPED

SWAGED

TUBE-HOSE ASSEMBLIES

# THE WEATHERHEAD COMPANY

FORT WAYNE DIVISION • Dept. AH-11, 128 West Washington Blvd. Fort Wayne, Indiana



Circle 155 on Time-Saver Card

**HANNIFIN**
has a faster, more rugged
**AIR MOTOR**

Truly a convenience package, the Hannifin Air Motor combines a rugged, low-friction, double-acting air cylinder with a solenoid valve. Ample air passages permit rapid cycling. Built-in speed controls make it possible to slow either or both strokes. Mounting dimensions interchange with most existing applications. "Off shelf" delivery in "standard" strokes. Bulletin 215—free on request—describes this new product.

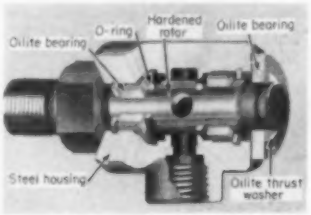
PARKER HANNIFIN CORPORATION
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS
**HANNIFIN COMPANY**
A DIVISION
545 South Wolf Road
Des Plaines, Illinois
3155-PH

Circle **63** on Time-Saver Card


# NEW PRODUCTS

## ROTATING UNION

Single-passage union is for air or oil. Two oilite bearings eliminate load which might be applied to O-rings. Hose entrance is between




O-rings—thrust from line pressure is balanced.

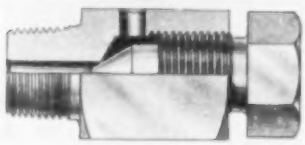
**Specifications:** For shaft speeds to 250 rpm. For 150 psi air, 2000 psi oil. For ¼" IPS hose connections. Rotors threaded ⅝"-18 right hand, ⅜"-18 NPT right hand male, or ⅜"-18 NPT female.

**Designation:** Model 15—*Deublin Co., Northbrook, Illinois.*

Circle **305** on Time-Saver Card

## AIR BLEEDER VALVE

Installed at hydraulic circuit's highest point. Eliminates all air



from system. Only two metal parts. No packings. All standard sizes in cadmium-plated steel. Specials in stainless steel.
*Lenz Co., Dayton*

Circle **306** on Time-Saver Card

## DYNAMIC PRESSURE METER

Measures static or dynamic pressure. Has up to four pressure sensors and electronic read-out unit. Measures and reads out individual pressures, pressure differentials, or

any arithmetic combination of up to four pressures. Plug-in units adapt strain-gage type pressure sensors to instrument. Each unit has balance, sensitivity, load, and calibration circuitry for its transducer, plus on-off control for each channel. Output terminals for external recording of signal. Rack-mounted or portable.

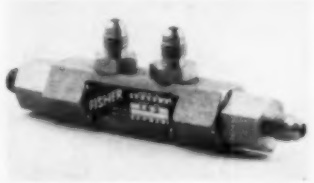
**Specifications:** Switch selects ranges of 0-300, 0-1000, and 0-3000 psi.

**Designation:** Model 689—*American Measurement & Control, Inc., Waltham, Mass.*

Circle **307** on Time-Saver Card

## DIFFERENTIAL PRESSURE GAGE SAVER

For fluid systems with operating pressures to 10,000 psi. Shut off at differential pressures from 30 to



2000 psi. ¼" tube and ¼" pipe connections. In aluminum and stainless steel.

**Designation:** Series DPGS—*Fisher Controls, Inc., Santa Monica.*

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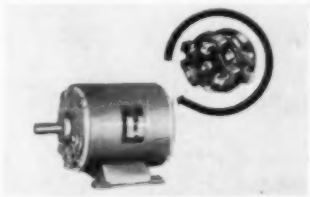
## ELECTRIC MOTORS

67 different types of 3-phase, open motors. Complete self-protection from severe overloads, stalling, single-phasing, unbalanced voltage, high ambient temperature, and



motor ventilation obstruction. Protector is assembled and completely wired inside motor.

**Specifications:** ¼ to 3 hp. Wide variety of voltages, speeds, and mountings.—*Kingston-Conley, Inc., Div. Howell Electric Motors Co., Plainfield, N. J.*

Circle **309** on Time-Saver Card

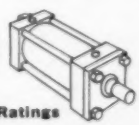

***For more NEW PRODUCT reviews turn to page 130***

# THIS ..IS WHAT YOU BUY!

POWER — clean, dry, drip-free power at the business end of a Hannifin piston rod is the result of Hannifin extra quality, and at no extra cost. Bores are honed to 15 RMS or finer . . . piston rods are case hardened, plated and polished to 10 RMS or better. Cartridge gland, removable without dismantling cylinder, has exclusive Hannifin-developed "Lipseal®-Wiperseal" combination for a truly drip-free rod.

Modern straight thread leak-proof ports for easily positioned fittings are available at no extra cost on hydraulic cylinders.

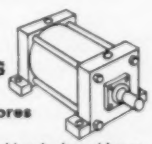
**HYDRAULIC CYLINDERS**



**Two Pressure Ratings**

**2000 psi** (3000 psi non shock), the famous heavy duty Hannifin Series "H" in 1½" to 12" bore.
**1000 psi**, Series "L", 1" to 8" bore, Hannifin quality in a lighter cylinder. Full compliance JIC Hydraulic Specs.

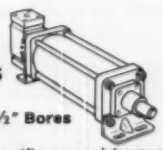
**AIR CYLINDERS**



**1½" to 14" Bores**

Series "A"—steel heads, honed brass body for corrosion resistance. Hardened and hard chrome plated piston rod. For all heavy duty air service. Easily modified for water service. Full compliance JIC Pneumatic Specs.

**AIR MOTORS**



**1¾" to 4½" Bores**

New from Hannifin, a complete power package combining cylinder and solenoid valve. Only one air line connection. Four mounting styles. Interchangeable mounting dimensions for most applications.

**HANNIFIN COMPANY**
A DIVISION
545 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

3128-PH



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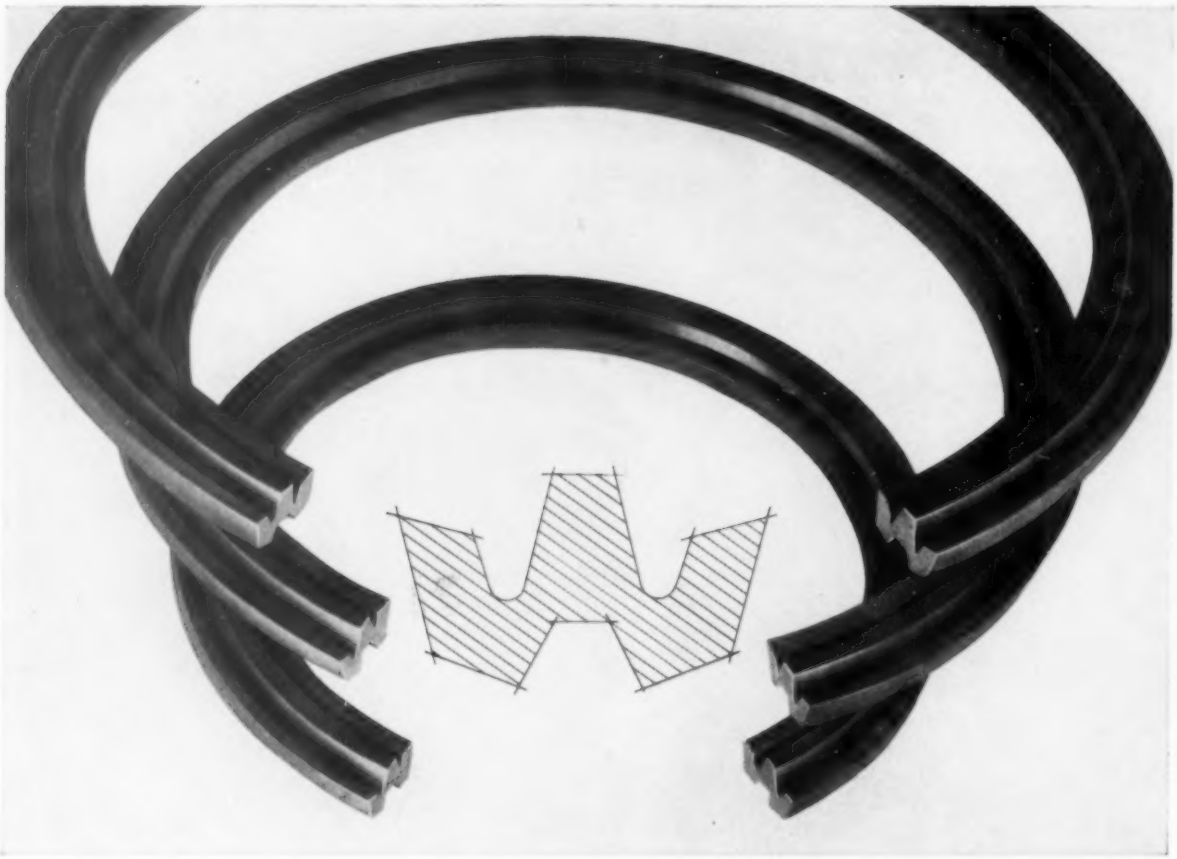
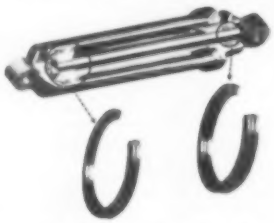


# Efficient sealing made to your measure... by JOHNS-MANVILLE

For equipment that requires other than standard packing styles, dimensions or materials . . . J-M offers made-to-your-measure custom moulded packings.

**3-YEAR PERFORMANCE TESTS PROVE LONG LIFE AND EFFICIENCY OF J-M UNEEPAC**



*For 3 years, a J-M customer gave Uneepac "the works." Uneepac Rod Packings got a 350,000-cycle test; Uneepac Piston Rings a 150,000-cycle test. Both provided a perfect seal for 3 years . . . proved able to stand working pressures to 2,500 psi and shock pressures to 4,000 psi!*

These packings are exactly engineered to measure up to your service conditions. J-M will select the materials that most economically handle temperature or other conditions. J-M will also recommend the specific design and construction needed, taking into account pressures . . . motions . . . and all other factors found within the equipment.

More and more manufacturers and those concerned with preventive maintenance now specify from J-M's broad selection of standard moulded automatic packings . . . or call on J-M's custom service. Either packing, whether standard or custom-made, is designed to give you optimum economy per packings dollar.

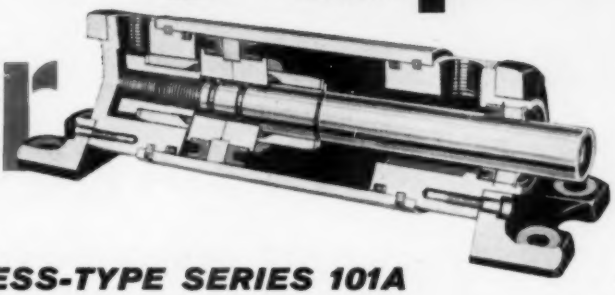
Here are some of the reasons why. Each pressure-actuated ring is an efficient, individual seal, interlocks with adjacent rings without compression adjustment. J-M packings are quick and easy to install. They are self-centering . . . self-adjusting . . . and offer interesting design possibilities. With J-M UNEEPAC®, for example, you can design smaller piston and rod stuffing boxes, and still get efficient sealing even in minimum packing depth.

Immediate shipment of all standard J-M packings. And complete information on J-M's entire line . . . plus specific recommendations for various applications and service conditions . . . is in free booklets PK-126 A and PK-148 A. See your J-M Distributor. Or write to Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS MANVILLE JM PRODUCTS

# America's First cO-Mpact Cylinder



## INTERNAL KEY TIE-RODLESS-TYPE SERIES 101A

*Air 150 psi—Hydraulic up to 1500 psi*

*Fits where others won't*

*Meets JIC Standards, Bulletin 101A*

Ruggedly constructed of steel with bronze bearings, this original space-saving cylinder is the most compact, streamlined and versatile cylinder available. It requires one-third less installation space and has a greater ratio of power to its size and weight than tie-rod-type cylinders with the same bore and psi rating. In addition, the ports can be rotated independently to any convenient location. It is easier to disassemble, for inspection and service and to re-assemble than any conventional-type cylinder. And, by using a majority of standard parts and one or two semi-standard parts, this component gives you the advantage of special cylinders that do a better job at a nominal cost.

Like all O-M cylinders, this compact unit has the lowest coefficient of friction. It is designed right to seal right . . . to make full-power starts on thrust and return strokes . . . to maintain perfect rod alignment . . . and cushion piston shocks. End plugs are tapped for universal mounting.

*Coupon brings Bulletin desired.*

**Bulletin 101A** for Internal Key Tie-Rodless Type Air and Hydraulic Cylinders featured above.
**Bulletin 105A**—Improved Tie-Rod (Heavy-Duty) Cylinders Hydraulic 2000 psi; 3000 psi non-shock.
**Bulletin 107**—Automation (Heavy-Duty) Air Cylinder for 200 psi operation.
**Bulletin 108**—Automation (Heavy-Duty) Hydraulic Cylinder —for 1000 psi operation.

*All O-M Cylinders are available in 1¼" to 8" bores with standard or heavy-duty rods. Complete line of mounts and interchangeable parts. Immediate delivery on most sizes.* **MAIL COUPON TODAY.**

**ORTMAN-MILLER MACHINE COMPANY**
**1 143rd Street, Hammond, Indiana**

☐ Have representative call

Send Bulletins

☐ 101A ☐ 107
☐ 105A ☐ 108

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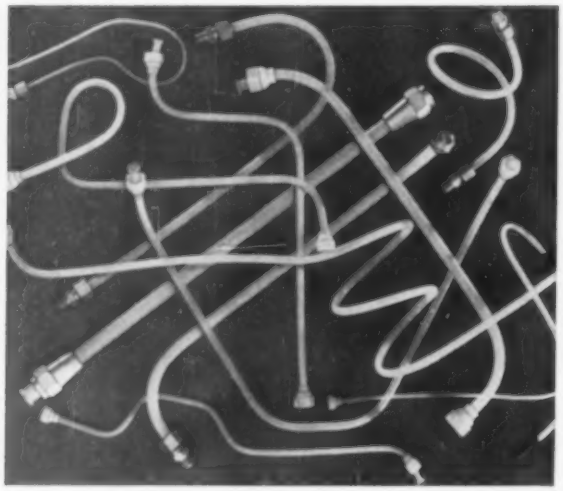
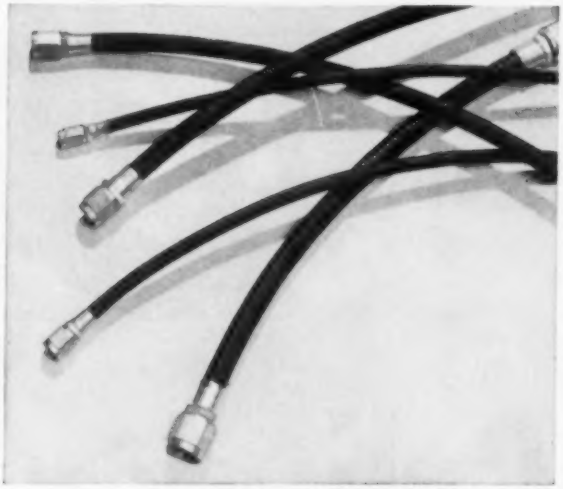
COMPANY_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

# NOW GET BOTH FROM ONE DEPENDABLE SOURCE!





## *NYLAFLOW*®

## Pressure Hose and Tubing

NYLAFLOW Flexible Pressure Hose—a new, all-synthetic polyamide tube reinforced with high tensile yarn and abrasion resistant cover*—or NYLAFLOW Pressure Tubing! Both are now available from the same dependable source.

**New NYLAFLOW Pressure Hose** weighs only 1/5 as much as rubber of equivalent burst strength . . . and has exceptional resistance to flex and vibrational fatigue.

Unaffected by flammable and non-flammable hydraulic fluids, hydrazine and other rocket fuels, with excellent resistance to caustics and most organic solvents. Freon permeability is approximately 1/10 that of rubber hose. Excellent non-conductor for use around high voltage lines.

Odorless, non-toxic, non-corrosive, fungus resistant and will not embrittle in storage. Temperature range (−65°F. to +250°F.). Form stable and can be permanently heat-formed to small, stress-free bend radii.

Burst pressure ratings of 5000 and 8000 psi.; available in long continuous lengths in standard diameters up to ½". Compact, light-weight, reusable fittings and assemblies also available.

**NYLAFLOW Pressure Tubing** in sizes up to ⅜" O.D., with burst pressure ratings of 1000 and 2500 psi., is ideal for lower pressure requirements. It is flexible for easy installation and can be attached with standard flare or compression fittings designed for metallic tubing.

*Patents applied for

Full details and illustrated brochures now available on new NYLAFLOW Pressure Hose and NYLAFLOW Pressure Tubing. Write today!

POLYPENCO® INDUSTRIAL PLASTICS

**The Polymer Corporation of Pennsylvania**

**Export: Polypenco, Inc., Reading, Pa., U.S.A.**



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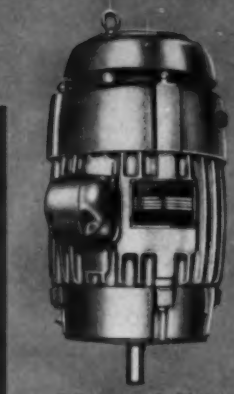
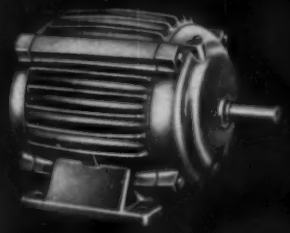
Circle 147 ⟶

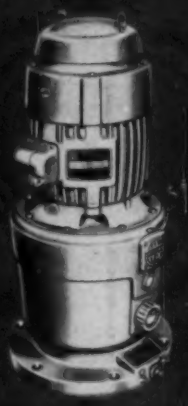
TOTALLY-ENCLOSED*
RIGHT-ANGLE WORM-GEAR
SYNCROGEAR MOTORS



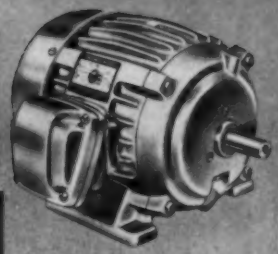
TOTALLY-ENCLOSED*
UNIMOUNT VERTICAL
SOLID SHAFT MOTORS



TOTALLY-ENCLOSED*
FANLESS TYPE
HORIZONTAL MOTORS



## total protection *in every direction.*

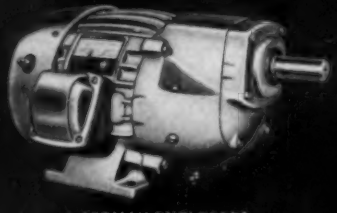


TOTALLY-ENCLOSED*
HORIZONTAL MOTORS

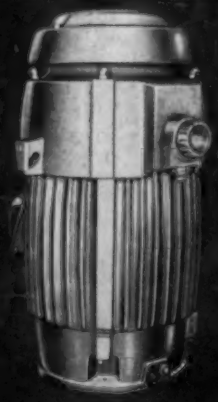
TOTALLY-ENCLOSED*
V-S DRIVE MOTORS

TOTALLY-ENCLOSED*
UNIBASE VERTICAL
SOLID SHAFT
PUMP MOTORS

TOTALLY-ENCLOSED*
DOUBLE REDUCTION
SYNCROGEAR MOTORS



TOTALLY-ENCLOSED*
SINGLE REDUCTION
SYNCROGEAR MOTORS



TOTALLY-ENCLOSED*
VERTICAL HOLLOWSHAFT
PUMP MOTORS

## *TOTALLY-ENCLOSED and/or EXPLOSION-PROOF U.S. MOTORS

...are offered in a wide range of sizes, horsepowers, speeds... for a multitude of applications. They are offered with and without internal gearing and/or variable speed drives. Like all U.S. Motors, they are *quality* built with *long-life* features such as asbestos-protected windings, normalized castings—and in the grease lubricated models, Lubriflush transverse lubrication. Totally-Enclosed models are intended for use in atmospheres and locations where dirt, rain, oil drippings, acids, alkali, erosive dusts, and similar adverse factors make it desirable to prevent outside air from passing through the motor. Available ½ to 150 H.P. Explosion-Proof motors in corresponding models are offered for highly hazardous locations in which explosive fumes or dusts are present. These motors carry the Underwriters' Label for Class I Group D, and Class II Groups F and G. Bulletins on the above motors are available. *Write to ...*

**U.S. ELECTRICAL MOTORS INC.**
P. O. Box 2058, Los Angeles, California or Milford, Connecticut

# USEFUL LITERATURE

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### TUBE FITTINGS

For plastic and metallic tubing. Grip plastic tubing without notching or distortion. Hold uniformly over wide temperature range. No danger of over torquing. Won't pull out. Catalog 602 has drawings and dimensions of connectors, elbows, unions, tees, nuts, collets, and inserts. *Commonwealth Brass Corp., Detroit.*

Circle **400** on Time-Saver Card

### PRESSURE-LOCK FILTER ELEMENTS

Folder explains advantages of pressure-locking process. End caps, center tube, and filter medium are mechanically locked under high pressure. Element is locked in parent metal of end caps to form leakproof seal. Process eliminates contamination from oxidation products and flux. Folder gives specifications for five types of elements covering rated flow capacities of 0.5, 3, 6, 12, and 24 gpm. Details on degree of filtration, temperature range, construction materials, fluids, and minimum collapse pressure. *Purolator Products, Inc., Rahway, N. J.*

Circle **401** on Time-Saver Card

### ADAPTER RINGS

Sealsaver hard-top-and-bottom rings provide strong, hard support for a set of softer V-rings. Will not extrude. Low-friction bearing surface. Rings breathe in adjustment to pressure variations and equipment motion. Formed from endlessly foiled fabric which resists fractures from any direction. They leave no raw edges exposed to pressure medium. For use where pressures are above 2000 psi, where clearances are larger than recommended, or where there is high radial loading. Bulletin SS-560 has test data. *Greene, Tweed & Co., North Wales, Pa.*

Circle **402** on Time-Saver Card

### O-RING HANDBOOK

Includes design and compounds. Cross-reference chart for O-rings and seals to AN, MIL, industrial and trade specifications. Has revisions to MIL-P-5514C gland design. 275 pp. *C. E. Conover & Co., Inc., Hasbrouck Heights, N. J.*

Circle **403** on Time-Saver Card

### HOSE CLAMPS

Folder F-310 describes hose clamps, production clamping machine, locking tools, and maintenance kit. Clamps have no projections. 6 pp. *Punch-lok Co., Chicago.*

Circle **404** on Time-Saver Card

### HYDRAULIC CYLINDERS

For 3000 psi. Carbon alloy or steel heads and rods. Cylinder bodies are heavy-wall steel tubing or centrifugally cast steel. Mountings are foot, front or rear flange, clevis, trunnion, rabbet, and intermediate. 1¾" to 12" bores. Catalog has drawings and tables of dimensions. Data on oversize rods, and how they affect mountings. Parts list. Notes on cushions, ports, and pistons. *Pathon Mfg. Co., Cincinnati.*

Circle **405** on Time-Saver Card

### SOLENOID VALVES

For air, oil, water, or vacuum. Internal parts resist corrosion. Singular unit construction. Synthetic seals can be replaced without removing valve from line. Only spring and plunger move. Manifold or body porting. 2-way valves have 3/64" to 3/16" orifices. For 0-200 psi. 2300 Series has 1⅝" dia, 3" height. ¼" and ⅜" NPT ports. 2400 Series also available with ½" NPT ports. Minimum increase in body size. 33800 Series 3-way valves have 1/8"-3/16" orifice, ¼"-⅜" NPT or AND ports. Available NC, or NO and momentary contact. 43000 Series 4-way valves are double-solenoid, base-mounted, direct-operated. 1/8" or 3/16" orifice. 1/4" NPT pipe size. Bulletin 91024 has parts lists, specifications, and dimensioned drawings. Shows flow patterns, explains valves' operation. *Airmatic Valve, Inc., Cleveland.*

Circle **406** on Time-Saver Card

### SMALL TUBING

Bulletin 42 tells characteristics and applications of all standard alloys. Lists special alloys. Gives features and specifications of various types of seamless and welded tubing. Aircraft hydraulic tubing in 304, 321, and 347 stainless steel. 3/16" to 1¾" OD. SAE carbon hydraulic tubing meets SAE, JIC, AMS, and ASTM specifications. Sizes from ⅛" to 1¾". Tables of size limits. *Superior Tube Co., Norristown, Pa.*

Circle **407** on Time-Saver Card

### THROTTLE VALVES

For air. Large, offset handles. Cylindrical spring pin fastens handle. Valves have handle stops in open and closed positions. Male in ½", ¾", and 1" NPT. Female in ½", ¾", 1", 1¼", 1½", and 2" NPT. Series 2500. Bulletin 460. 4 pp. *Hose Accessories Co., Philadelphia.*

Circle **408** on Time-Saver Card

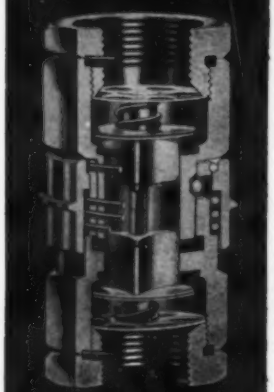
***For more reviews of FREE LITERATURE turn to page 146***

## Snap-Tite *valved* couplings stop flow instantly"

Snap-Tite provides instant shut-off wherever fluid coupling is needed.

Snap-Tite *valved* couplings connect and disconnect quickly and fully—they automatically open line flow when connected; positively seal your line when disconnected—with no "ifs," no chance for human error.

Snap-Tite couplings are available in sizes from ¼" to 6" ID, in steel, brass, aluminum, 303 ss and 316 ss. Sizes from 6" to 10" ID are available on special order. For more information, write for Snap-Tite catalog #58. Snap-Tite representatives are located in all principal cities.



Provided with valves to give two-way or one-way automatic line shut-off.

Built to handle high pressure hydraulic and pneumatic systems

**SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS**

Snap-tite

ST-59-05

UNION CITY, PA.



Circle **135** on Time-Saver Card

The "custom" approach to oil seal manufacture, pioneered by IPC, has resulted in some real off beat products.

None-the-less . . . they *work!* They suit the application *and,* in more cases than not, they have contributed substantially to cost savings.

When you're faced with a rugged problem involving oil seals, what synthetic compound comes to mind? How about case design? . . . friction? . . . torque? . . . shaft speeds?

*Oil seals are an engineered product in themselves* . . . just as good as their individual design. That's why we think each oil seal application deserves special "custom" thinking. That's why IPC oil seals are noted for performance. Let us show you what IPC can do to relieve your particular problem.

OIL SEALS / PACKINGS / PRECISION MOLDING *Custom designed for your application.*

IPC **INTERNATIONAL PACKINGS** CORPORATION

Bristol, New Hampshire

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P-1

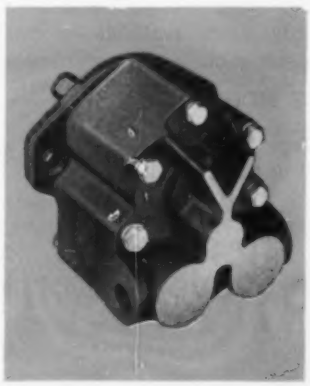
## Webster hydraulics power a clean sweep

The business end of an industrial floor sweeper has its work cut out. Cleaning up grease-caked debris, metal chips, oil and grit is a tough demanding chore. It takes power — *versatile* power.

And a Webster HCS hydraulic motor supplies it for one of the most popular sweepers of this type! The HCS drives *both* the brush and the machine — maintains constant brush speed regardless of propelling speed. It has high torque with low power requirements (ideal for this application) and mounts in *any* position.

The HCS, typical of all Webster hydraulic motors and motor-pump combinations, operates at up to 1000 psi, with up to 206 torque pounds/inches per 100 psi (theoretical). It delivers up to 57 hp at speeds up to 2000 rpm.

Would a Webster hydraulic motor, pump or valve adapt to your product? Would it solve a power transmission problem? There's one way to find out — ask the advice of a specially trained Webster hydraulics engineer. There's no obligation. Write for action!



HCS HYDRAULIC MOTOR
Write for complete specifications and performance data.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE · WIS

# PACKLESS

**4-way, balanced, lapped spool and body assembly eliminates seals to provide**

# 50 MILLION CYCLES

**of total reliability in Alkon's new Series A ¼" air valves for vacuum to 200 psi air service. Carbide-hard working and sealing surfaces at these**

# LOWEST PRICES

| | | | |
|---|---|---|---|
| single solenoid valve | $34.50 | double bleeder valve | $25.00 |
| double solenoid valve | 49.00 | hand valve | 21.00 |
| single pilot valve | 21.00 | foot valve | 23.00 |
| double pilot valve | 22.00 | palm button valve | 20.50 |

All actuators — hand, foot, solenoid, pilot and bleeder — in single or double combinations available for maximum circuit flexibility, easy installation, less maintenance.

**SUB-BASE MOUNTING FREE**

ALKON also manufactures versatile cylinders and pneumatic drill units.

Write today for new free 24 page catalog.

**Alkon Products Corporation**

**200 Central Avenue, Hawthorne, New Jersey • HAwthorne 7-6633**

*alkon*

Melting furnace at Calumet & Hecla, Inc.—Wolverine Division, where Shell Irus Fluid 902 eliminates the danger of hydraulic line fires.

# Ready... aim... NO FIRE!

Take 10 high-temperature alloy-melting furnaces, hydraulically operated—each pouring 1500 lbs. of molten metal every hour in close proximity to "live" hydraulic lines—and you can readily see why selection of hydraulic fluids is important to Calumet & Hecla's Wolverine Tube Division.

Now the operation is made more reliable by the use of Shell Irus Fluid 902, a water-in-oil emulsion type fluid. Irus® Fluid was C & H's choice, after carefully studying other commercial hydraulic fluids—for many reasons:

1. Irus Fluid will not support combustion.
2. Irus Fluid has excellent lubricating properties.
3. Irus Fluid has hydraulic efficiency and equipment compatibility.
4. Irus Fluid is economical, costing about one-third less than other fire-resistant fluids.
5. Irus Fluid's bright yellow color makes it easy to spot and trace leaks.

In plant after plant, operators find that these advantages assure maximum safety to both personnel and equipment.

If you have a hydraulic line fire hazard, we suggest that you have the Shell Industrial Products Representative show you the many advantages in Irus Fluid 902; or write to Shell Oil Company, 50 W. 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif. In Canada: Shell Oil Company of Canada, Ltd., 505 University Ave., Toronto 2, Ontario.

AN INTERESTING FACT!
Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the **Irus** elliptieus.

**SHELL IRUS FLUID 902**

*the low-cost, fire-resistant hydraulic fluid*

SHELL

Improved reliability • Greater capacity • No increase in price

# NEW DIRECTIONAL VALVE DESIGNS

# WITH VICKERS Q-E-L* SOLENOIDS

- New Q-E-L* solenoids assure quiet, cool operation plus shock-free performance through superior cushioning.
- Four to five times more cycle life than previously obtainable with ordinary air-cooled solenoids.
- Capacity increased from 50 to 500% on new designs.
- All models suitable for pressures to 3000 psi.
- Complete range of sizes available for maximum flows to 440 gpm.

**MODEL DG4S4** is rated at 8 gpm (with nominal pressure drop) with a maximum allowable capacity of 12 gpm without malfunction. Maximum recommended operating pressure is 3000 psi. Standard subplates are available with ⅜ in. or ½ in. pipe thread ports. SAE straight thread port connections can also be provided.

**MODEL DG5S4** solenoid-controlled, pilot-operated valve is rated at 30 gpm (with nominal pressure drop) with a maximum capacity of 80 gpm without malfunction, depending on circuit conditions and valve type. Standard subplates are available with ¾-in. and 1 in. pipe thread connections. SAE straight thread port connections can also be provided. Write for Catalog 5001-C.

8596

* Q-E-L designates Quiet Extended Life solenoid—a *Vickers exclusive.*

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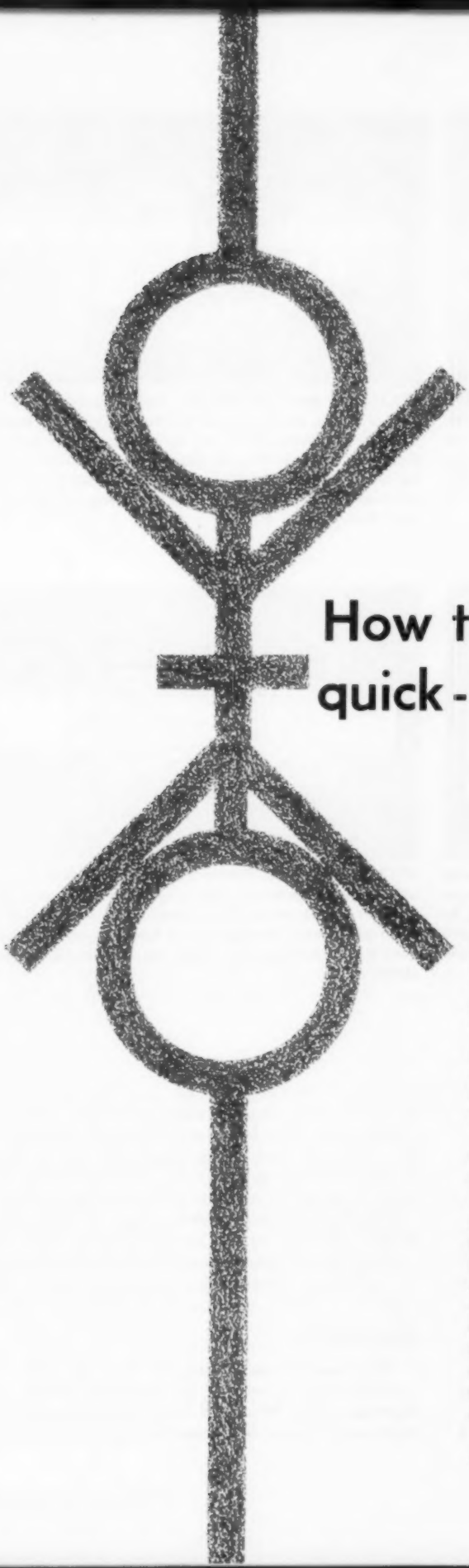
Hydraulics & Pneumatics

NOVEMBER 1960



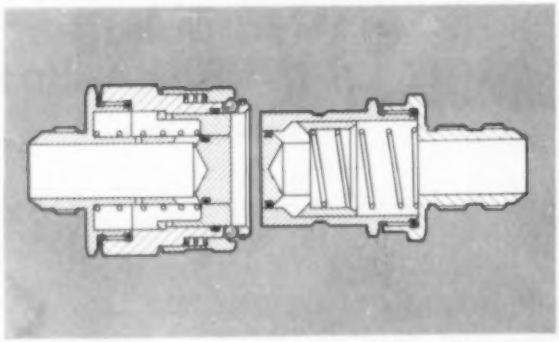
# How to select quick-connect couplings

• By **JACK LOWERY,** *Associate Editor*

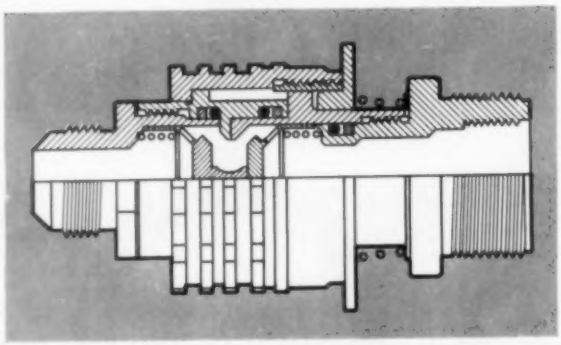
IF YOU connect and disconnect an air or oil line more than once a week, a quick-connect coupling will probably save you money. They make and break a fluid line with less effort than it takes to open your water faucet. They have a female end called a socket or coupling and a male end called a plug or nipple. They're connected by pushing the two ends together, and locked in place with balls, dogs, cams, pins, pawls, or screws. Some can be connected with one hand, others require turning or sliding a sleeve to lock and unlock the coupling.

Quick-connect couplings were originally introduced to connect portable air tools such as drills, grinders, riveters, and impact wrenches to air supply lines. They are now being used in many high pressure hydraulic and pneumatic systems for industrial, mobile, and aircraft applications. Mobile uses include connecting air brake lines and hydraulic lines to accessories. They're used in aircraft to speed replacement of faulty system elements, provide breakaway connections for jettison seats and canopies, and permit rapid connection and disconnection of lines through aircraft firewalls, and wing joints. They also connect fluid to missiles during testing and are remotely disconnected when the missile leaves the ground.

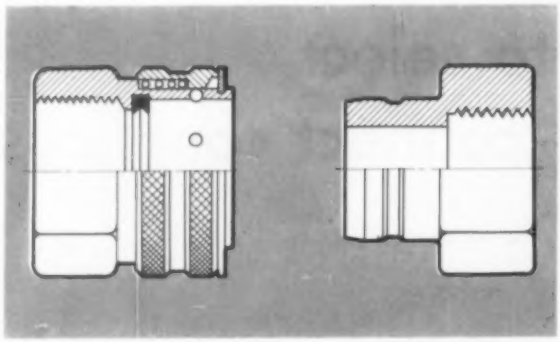
Quick-connect couplings may be either self-sealing or open type. Self-sealing couplings have a valve in the



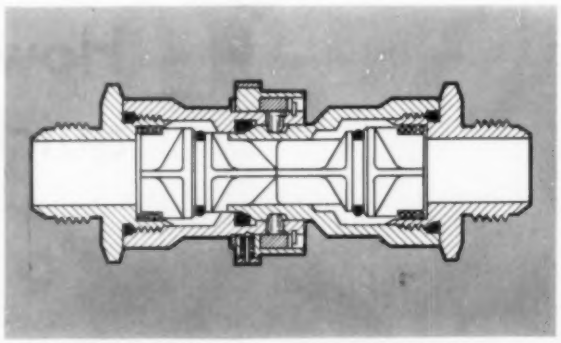
**SLEEVE VALVE IN THE SOCKET** holds the locking ring cocked while the coupling is disconnected. When the nipple is pushed into the socket, it moves the valve sleeves back, opening the valves. The balls drop into the lock race and the locking ring slides over the balls, locking the coupling together. *Snap-Tite Corp.*



**HELICAL GROOVES** in the socket sleeve mate with prongs on the nipple to lock the coupling halves together. Turning the sleeve 30° gives an audible, visual and touch indication of lock. The coupling is disconnected by pushing the lock flange. Poppet valves and seats are hardened stainless steel for high temperature operation. *Ozone Aircraft Components Corp.*



**V-TYPE BUTT SEAL** prevents external leakage in this straight-through coupling. End face of the nipple compresses the packing when the coupling is assembled. As pressure increases, sealing force increases. A ball lock holds the coupling halves together. Made also with poppet valves in the socket and nipple. *Titeflex Inc.*



**LOCKING PINS** are driven into the nipple locking groove by a rotary cam in the lock ring. Chamfered mating surfaces in the groove pull the nipple into a tight lock. Uniform pin contact on the socket body, nipple groove, and cam evenly balance the forces on the coupling. *Jack & Heintz, Inc.*

socket, or in the socket and nipple, to prevent loss of fluid when the coupling is disconnected. Open couplings have no valve.

One coupling designed specifically for air tools has an integral 3-way valve which exhausts the line from the tool to atmosphere before the coupling opens. Air supply to the coupling is shut off in the socket.

Standard couplings are made of brass, aluminum, steel, and stainless steel depending on the pressure and fluid requirements. Seals are available for air, and petroleum base and fire-resistant hydraulic fluids.

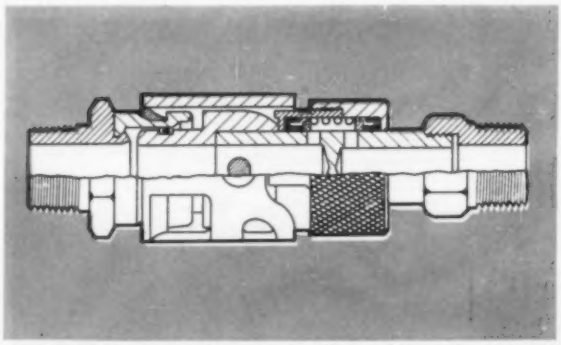
Standard couplings are made from ⅛ in. to 4-in. end connections for male and female pipe threads, straight threads, hose shanks, and reuseable hose ends. Flanged ends are also available for bulkhead mounting or mating with another flange.

Breakaway couplings are a variation of standard couplings. They are used on farm tractors to connect trailing implements with the tractor's hydraulic system. They disconnect automatically by the pull on the hydraulic lines if the implement breaks away. When uncoupled, each half seals itself preventing loss of hydraulic fluid or entry of dirt into the system.

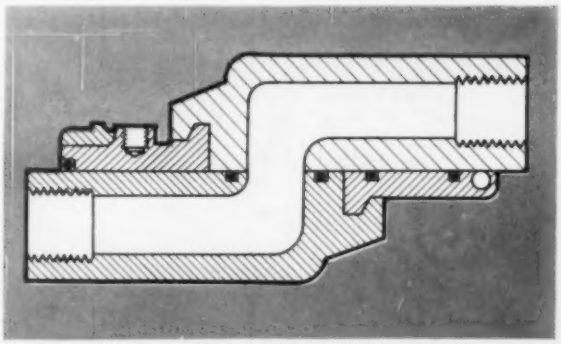
Coupling valves are either poppet or sleeve type. Poppet valves are opened by their stems or faces butting against each other when the socket and nipple are assembled and locked. Sleeve valves open when a sliding sleeve uncovers ports as the coupling is connected.

## STRENGTH

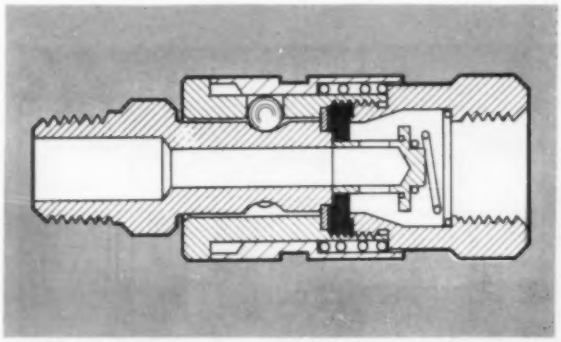
Quick-connect couplings are pressure rated by their manufacturers according to operating, proof, and burst pressures. Proof and burst pressure rating vary with coupling size. Minimum proof pressure rating is



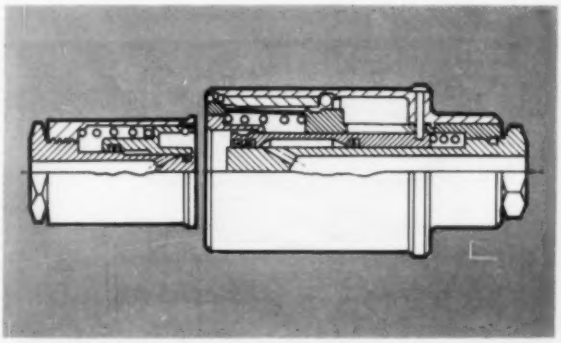
**3-WAY VALVE, operated by sliding a brass sleeve over stainless steel body, shuts off supply air and exhausts air downstream of the coupling. Valve operation does not disconnect the coupling. Cadmium plated steel jaws fit around machined shoulders on the nipple to lock the coupling together. Brass sleeve locks jaws in position. Coupling is designed for use with air tools. *Hunt Valve Co.***



**FLAT SEALING SURFACE allows greater flow area through the coupling and keeps pressure drop low. When coupling is assembled, two slides uncover flow ducts. A manually operated lock bar holds the coupling halves together. The lock allows the coupling to part in an emergency without breaking the hose. *Char-Lynn Co.***



**STRAIGHT-THROUGH NIPPLE with sleeve valve in the socket. When the coupling is assembled, the nipple pushes back the sleeve in the socket opening the valve ports. Both nipple and valve are sealed by a single elastomeric seal. Various seal materials are used depending on the fluid handled. Steel balls, held in place by a locking sleeve, hold the coupling halves together and allow it to swivel. *Tru-Flate, Inc.***



**BALANCED VALVE in the socket permits assembly of the coupling under pressures to 4000 psi. When the nipple is pushed into the coupling, locking fingers hold it in place. The valves are then opened by sliding the actuating sleeve. A ball type lock prevents opening the valves until the fingers grip the nipple. *On Mark Couplings, Inc.***

usually 1½ times operating pressure and burst pressure rating 2½ times operating pressure. Standard couplings for hydraulic service are rated for operating pressures to 10,000 psi.

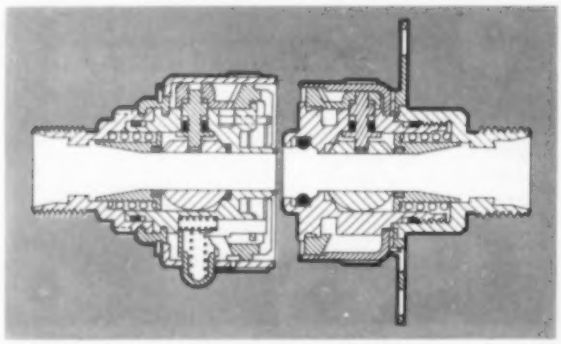
Coupling strength is determined by its material, body thickness, and locking means. Brass and aluminum are used for low pressures and steel and stainless steel for higher pressures and temperatures. Body thickness is limited by allowable weight and envelope dimensions of the coupling. Locking strength is determined by the number and size of balls, pins, dogs, or cams. Overpressuring a ball type lock causes the balls to penetrate the nipple, sometimes called brinelling. This can be prevented by using additional balls in the lock for high pressures.

Military specifications MIL-C-25427 (ASG), governing quick-connect couplings for hydraulic service require that they withstand a 20g shock loading without disconnecting or damaging the coupling. The specifications also require a 25-hour vibration test at the resonent frequency of the coupling. If the coupling has no resonent frequency, it's vibrated at 55 cps and a double amplitude of 0.06 inch.

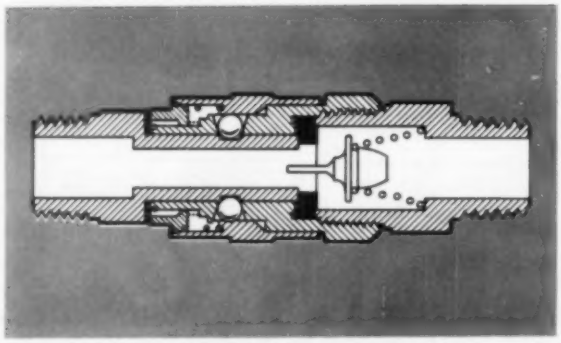
## COUPLING

Many self-sealing couplings can be disconnected under normal operating pressure. However, manufacturers generally recommend 500 psi as the maximum line pressure under which couplings should be connected. With larger couplings where a greater valve area is exposed to line pressure, it may be impossible to connect the coupling by hand without further reducing line pressure.

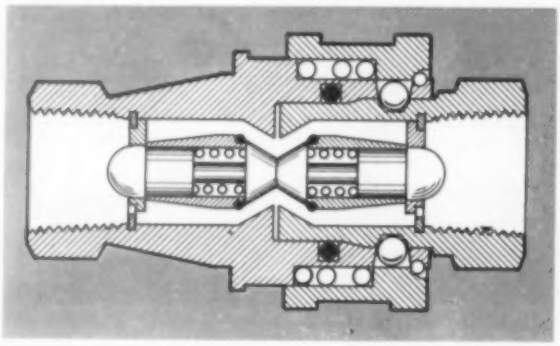
One pneumatic coupling for connecting under 4000



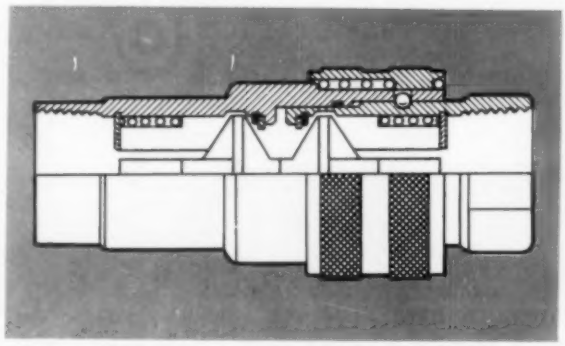
**BALL VALVES** seal both halves of the coupling when it's disconnected and permit unrestricted flow when connected. A pinion gear rotates the ball valves 90° when the coupling is connected and disconnected. A ring gear attached to the locking ring turns the pinion when the locking ring is turned to connect and disconnect the coupling. A bayonette lock holds the two halves together. *The Weatherhead Co.*



**SELF-SEALING SOCKET** with an open nipple. It can be coupled with one hand. When the nipple is inserted into the plug, the extension on the poppet valve stem opens the valve. A single washer seals the poppet valve when the coupling is disconnected, and seals the nipple when connected. *Perfecting Service Co.*



**STREAMLINED POPPET VALVES** open by butting against each other when the coupling is connected. Synthetic gaskets bonded to the poppets seal both halves of the coupling. Valve springs are inside the valve bodies to keep them out of the fluid stream. Valves in the socket and nipple are interchangeable. *Hansen Manufacturing Co.*



**GUIDED POPPETS** seal both halves of the coupling before assembly. The poppet's fluted stems press against each other and open when the socket and nipple are assembled. A ball lock holds the coupling together. *Stratoflex, Inc.*

psi uses valves balanced by line pressure on both sides. Its valves open mechanically without springs to avoid any impulse when connecting. The coupling is also keyed to prevent mismating different fluid lines. The nipple end has indexed keys in the correct number and position so that it can only connect to a socket with identical indexed slots.

## LOCKING

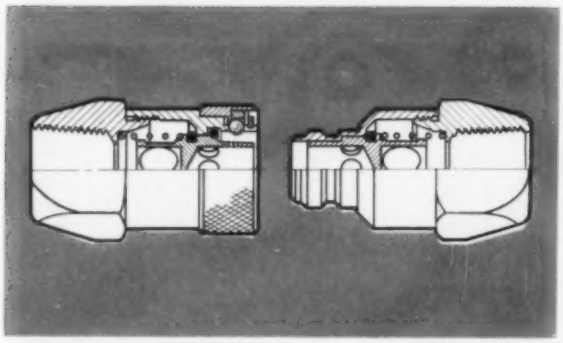
In a self-sealing coupling, the lock serves two purposes: it holds the valve or valves open, and it locks the two coupling halves together. There should be no position where the valves are open and the coupling is not locked.

Couplings are locked with detented balls, pins, dogs, pawls, cams, bayonets, or screw threads. The ball type lock is the most widely used and allows the nipple to swivel when connected. However, in some designs, pins, dogs, or cams offer a space or strength advantage. The locking collar may operate axially or radially.

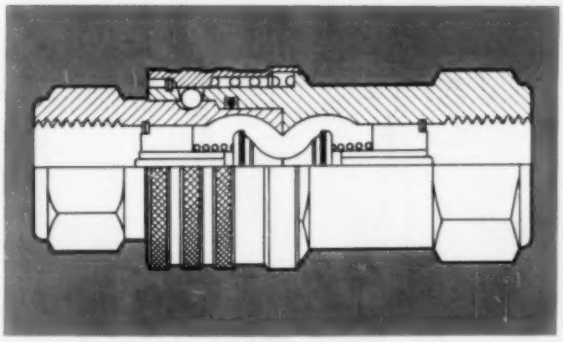
Couplings for high pressure service should have an audible and visible indication when they lock. They should also have a means for checking the lock by touch.

## FLUID LOSS

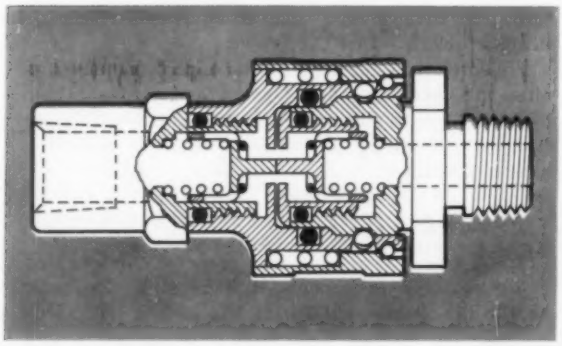
Air inclusion and fluid loss while connecting and disconnecting a self-sealing coupling depends on the volume between the valves just prior to connecting, and how rapidly the valves close when disconnected. Solid stem poppet valves generally allow more fluid loss than hollow poppets or sleeve valves and drilled passages. However, pressure drop caused by fluid direction change through the drilled passages is greater than



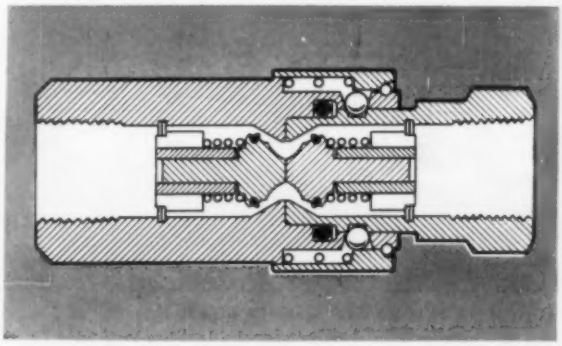
**SLEEVE VALVES butt against each other and slide back, opening drilled ports when the coupling is connected. To lock the coupling after assembly, the lock ring is turned and cams force steel balls into a groove on the nipple. As the balls reach the end of the cam, they drop into a lock pocket with an audible click. Made in aluminum, steel, and stainless steel. *Airaterra.***



**METAL-TO-METAL POPPET SEAL in both the socket and nipple, together with a retained O-ring in the poppet, assure leakproof sealing. Valve profile allows 20% more area through the coupling than through connecting fittings. Locking sleeve on socket moves back to disconnect and snaps forward to connect the nipple. *The Bruning Co.***



**MINIATURE COUPLING for ½ gpm fluid flow uses a double poppet valve design. O-rings seal against external leakage when connected and disconnected. The coupling is rated at 1500 psi operating pressure and weighs about 1 oz. *Eastern Industries, Inc.***



**SOLID POPPET VALVES have captive elastomeric seals for leakproof operation at low pressure. At high pressures the seals compress and the poppets seal on the metal seat. Couplings are made of steel and have a pressure rating of 3000 psi. *Aeroquip Corp.***

that through a poppet valve.

After coupling, external leakage is prevented by elastomeric seals in the coupling. They seal either on the end or the outer diameter of the nipple. Sealing on the nipple diameter permits some relative movement between the nipple and socket. End or butt seals require closer nipple and socket alignment but give longer wear life.

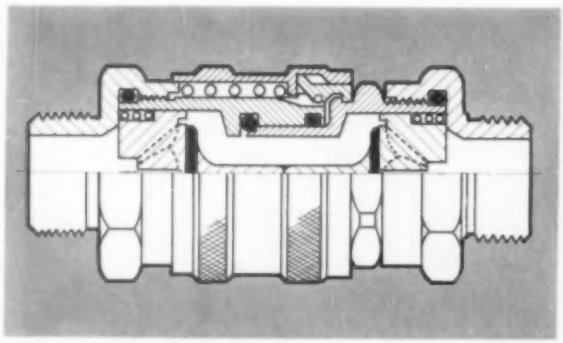
O-rings, V-rings, U-rings and some special cross-sections are used. Seal composition depends on fluid being handled. Teflon is used for some high temperature hydraulic fluids; however, it generally requires reinforcing to prevent cold flow.

## FLOW RESTRICTION

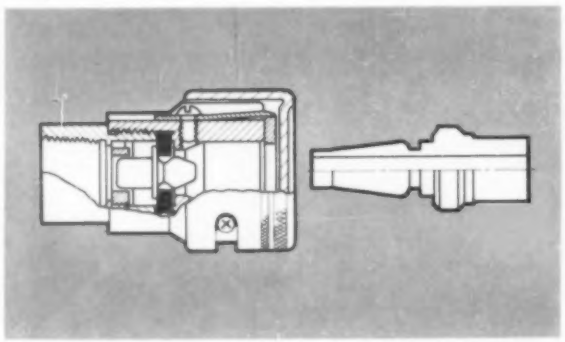
An important consideration when selecting self-sealing couplings for air or liquid service is pressure drop through the coupling. Internal valve design and flow path through the coupling determine the pressure drop.

Fluid flow in poppet valve couplings is generally around the poppet. However, in some couplings, the poppets are drilled, and fluid flows through the valve stem. Sleeve valves in couplings are opened and closed by a drilled sleeve moving axially in the coupling opening or closing ports in the body. The solid poppet valve usually offers the least resistance to flow, but on liquid service it allows more spillage and air inclusion than the hollow poppet or sleeve valve when connecting and disconnecting.

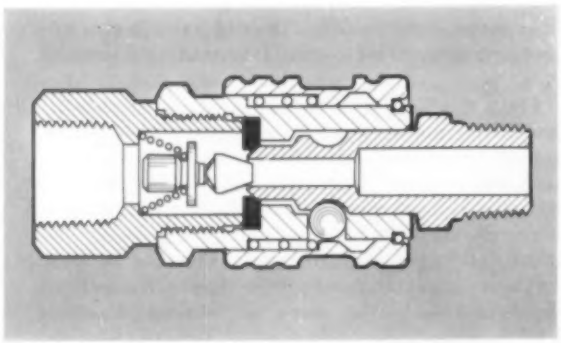
One manufacturer uses ball valves to seal the coupling halves when disconnected. When the coupling connects, a ring and pinion gear turns the ball to its open position. When connected, there is an unobstructed flow path through the coupling and the pres-



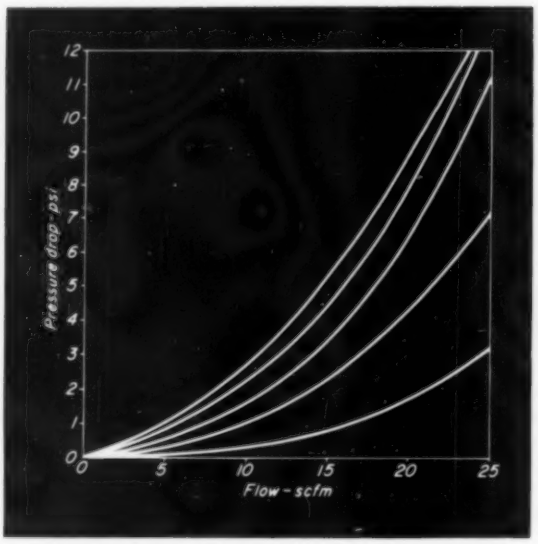
**DOUBLE O-RING NIPPLE SEAL prevent loss of fluid when connecting and disconnecting. The nipple engages one seal at the extreme outer end of the socket and it butts against another seal when it's fully connected. Positive locking is assured by dogs held in place with a lock ring. Disconnects by pulling back the lock ring. *E. B. Wiggins Oil Tool Co., Inc.***



**SPRING-LOADED PAWLS lock the nipple into the socket. When the nipple is pushed in and the locking ring turned, leaf springs depress pawls into the locking groove on the nipple. A flat washer seals the poppet valve when the coupling is separated and seals the stem against external leakage when connected. *A Schrader's Son, Div. Scovill Mfg. Co., Inc.***



**CONICAL SPRING holds the poppet against the seal washer when the coupling is disconnected. When the nipple is inserted into the socket, it moves a flat extension of the valve stem, opening the poppet. A ball lock holds the coupling halves together. *United States Air Compressor Co.***




**PRESSURE DROP through various 1/4-inch self-sealing couplings at 100-psi inlet pressure.**

sure drop is no greater than an equivalent length of straight tube.

Pressure drop through quick-connect couplings is often the cause of reduced speed and torque of air tools. The curves show pressure drop for five different 1/4-inch, self-sealing couplings at 100 psi and flow rates to 25 cfm.

## SIZE AND WEIGHT

These two considerations are generally determined by the coupling requirments. If the pressure drop must be low, the coupling must have a large flow path. This increases its overall size. Higher pressures require larger locking mechanisms and heavier cross-sections. Aluminum is used for high pressure couplings when size is not important. However, space requirements on most missile and aircraft applications require a smaller coupling. Steel or stainless steel must then be used if the overall envelope size is to be reduced and the same flow and pressures maintained.

Severe restrictions on the envelope size and weight generally require a compromise in pressure drop or overall strength of the coupling. ▼▼▼

Editors of HYDRAULICS & PNEUMATICS wish to thank the following companies for their cooperation in furnishing material for this article:

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*This concluding article is part of the first-prize entry in the 1960* HYDRAULICS & PNEUMATICS *Prize Paper Contest. Part 1 which appeared last month compared basic characteristics of spool, flapper-nozzle, and jet-nozzle servovalves.*

# Principles of servovalves

• By **WERNER G. HOLZBOCK,** *Consulting Engineer, Nashua, New Hampshire*

## PART 2

THE ANALYTICAL approach of part 1 has led to the design of single-stage, jet-nozzle servovalves described in this article. Patent applications for these designs have been filed by the author.

These single-stage valves can also be used as the first stage in two-stage valves.

• **Jet-Nozzles**—The principle of the jet-piston is illustrated in Figure 1. The jet-nozzle is a tapered flow passage across the piston axis. Moving the jet piston up and down directs the jet toward either of the receiving orifices.

The piston may also rotate through a small angle. The plane of the receiving orifices would then be changed so that the jet-piston's angular motion would distribute hydraulic pressure between the two receiving orifices.

Jet-nozzle designs are illustrated in Figure 2. Design *a* is a tapered nozzle, *b* shows a much shorter taper, *c* is a straight nozzle which is one of the most efficient. Its length should be equal to its diameter. Figure 2*d* illustrates a hollow jet-piston. Flow passes through the piston and out through a hole in the wall. Turbulence resulting from the 90-degree bend is reduced by making the piston's inside diameter very large compared to jet-nozzle diameter. The design of figure 2*e* is the same as *d*, except it has two opposite holes. This balances forces caused by hydraulic pressures. However, it complicates the servovalve design because the two jet-nozzles require two sets of receiving orifices acting in parallel. These orifices have to be connected either externally or internally. The designs shown in Figure 2, particularly *a* through *c* do not have to be cylindrical.

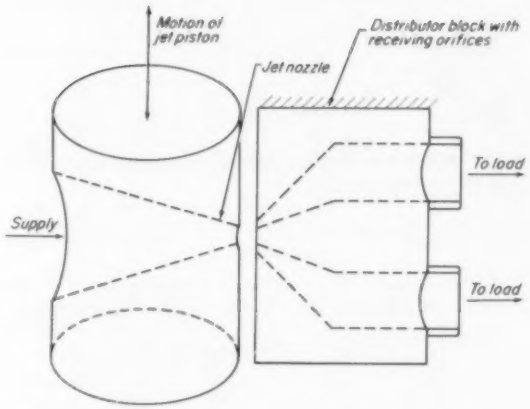



**FIG. 1. JET-PISTON** may move up and down or rotate to control flow to receiving orifices.

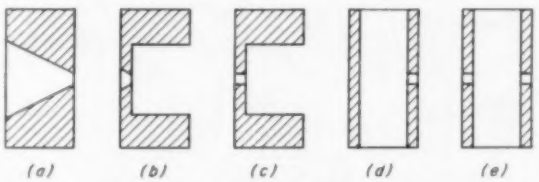



**FIG. 2. JET NOZZLE DESIGNS.** In designs a, b, and c flow is from left to right. In d and e flow is through hollow piston and out through orifice(s).

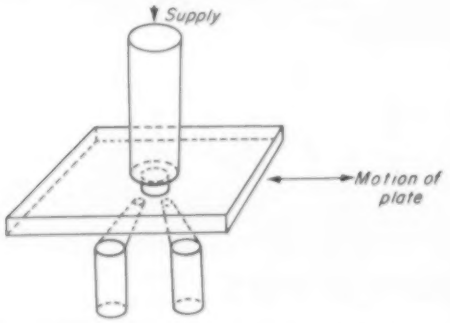



**FIG. 3. JET-PLATE** between supply and receiving orifices moves horizontally to control flow.

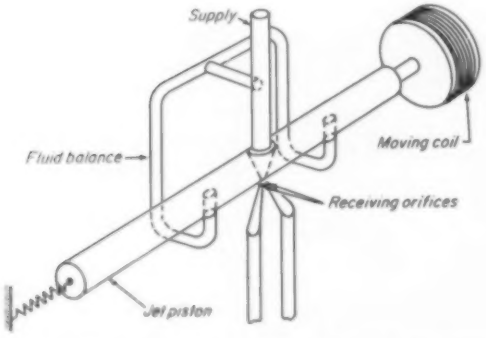



**FIG. 4. FLUID BALANCE** counteracts force exerted by pressure fluid acting against nozzle area.

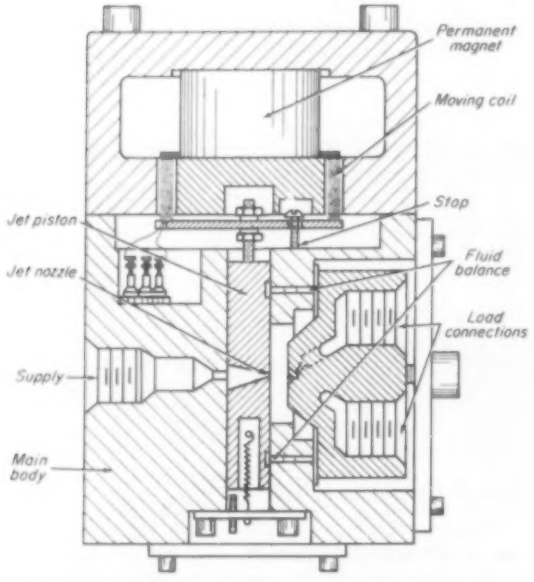



**FIG. 5. JET-PISTON SERVOVALVE** with fluid balance.

The jet-plate illustrated in Figure 3 shows another novel approach. It is actually used in a design discussed more fully below. The jet-plate moves freely between the supply passage and the receiving orifices and directs the jet to any position between the two orifices.

• **Fluid Balance**—Force exerted by fluid pressure acts against the nozzle area of a jet-piston. This pushes the piston against its bore and creates friction. This force can be balanced by the design diagrammed in Figure 4. Hydraulic pressure is applied to oppose force on the nozzle area. Total area on which hydraulic area acts in one direction must equal pressure area in the opposite direction.

Figure 5 shows the design of a jet-piston servovalve with fluid balancing. The piston connects to a moving coil which positions it.

A further refinement is to enlarge the balancing pressure areas and make balancing pressure adjustable. This is done with a small jet-pipe in the fluid balance line. This jet-pipe is manually adjustable. The arrangement has a continuous leakage loss, but permits adjusting the balancing pressure, and balancing the piston so that it floats in oil without touching the walls of the bore in which it slides.

• **Drain Pressure Balance**—Fluid balance compensates for changes in supply pressure, but not for changes in drain pressure. Drain pressure acts against part of the piston surface opposite the inlet. Where drain pressure changes, either a pressure regulator must be used or drain pressure can be used as a balancing force. For example, suppose that drain pressure acts on 10 times more piston area than supply pressure. A pressure regulator across supply and drain maintains supply pressure at 10 times drain pressure to balance the piston. Any area-pressure ratio can be chosen. Exact dimensions for the respective areas do not have to be maintained, because the pressure regulator can be adjusted for balance.

• **Suspensions**—The suspension arrangement shown in Figure 6 is another way of eliminating friction. Flat strips of spring steel hold the jet-plate. The jet-nozzle swings in front of the oil supply. Clearance between plate and body can be kept to a minimum by adjusting the leaf-spring mounting. This makes leakage between supply and jet-nozzle negligible and still prevents any metal-to-metal contact. The leaf springs take up the force of hydraulic pressure acting against the jet-plate. The resulting elongation of these springs must be considered. However, even for cross-sectional areas as small as .002 sq. in., elongation can be tolerated, particularly since it can be taken into account in the initial length adjustment of the suspension.

A slightly different suspension is illustrated in Figure 7. The jet-plate swings between two flat springs. This results in a lifting of the jet-plate. The approximate magnitude is given by:

$$h = \frac{x^2}{2L}$$

where:

h = lift
x = jet-nozzle displacement
L = strap length

In a typical case, $x$ is .03 inch and $L$ is 1.5 inch. This gives a lift of .0003 inch. The necessary clearance must be provided.

There is a more serious phenomenon in this arrangement. Hydraulic pressure acts at right angles to the plate, resulting in a force which is taken by flat springs. In the center position, the force is parallel to the flat spring. As the plate is displaced, the flat springs move through a small angle. Since the force is no longer parallel to the flat springs, there is a force vector which tries to bring the flat springs back to their initial position. This force vector acts like a spring and its equivalent spring rate is quite high. Therefore, the desgn is limited to comparatively low hydraulic pressure and high power input signals.

This is a good example showing where a torque motor could be applied rather than a moving coil. The torque motor spring rate discussed in Part 1 is so large that the equivalent spring rate of hydraulic forces could readily be absorbed. This design with a torque motor could well be used for high pressure, fluid power.

With a low power input, high hydraulic pressures and a moving coil, the suspension shown in Figure 6 would be better than the one in Figure 7. It is used in the design of Figure 8. The moving coil is suspended between two leaf springs and connects to the jet-plate with another leaf spring. The horizontal axis of the coil remains horizontal and does not follow the angular motion of the jet nozzle. This permits a narrower air gap for the moving coil and greater efficiency of the magnetic structure. The whole assembly moves without any recognizable friction.

Although the leaf springs provide part of the counterforce to the input signal, a coiled spring is needed for

Continued on page 86

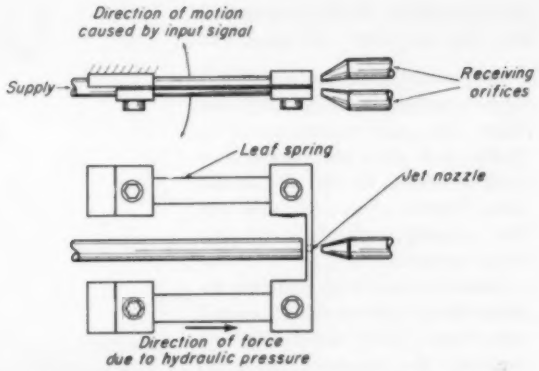



**FIG. 6. JET-PLATE SUSPENSION** eliminates friction. Leakage between supply tube and jet nozzle is negligible because springs are adjusted for minimum supply/nozzle clearance.

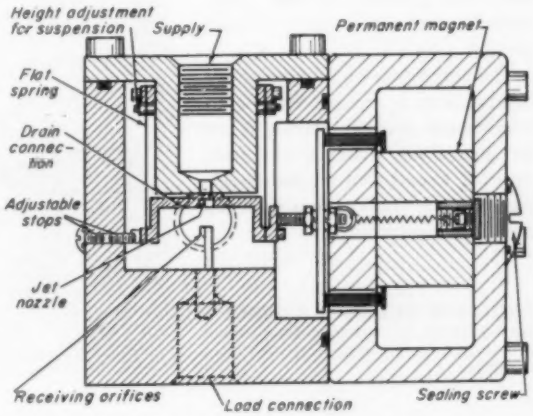



**FIG. 7. JET-PLATE SERVOVALVE** with flat spring susupension. This design is suitable for low pressure and high power, input signals.

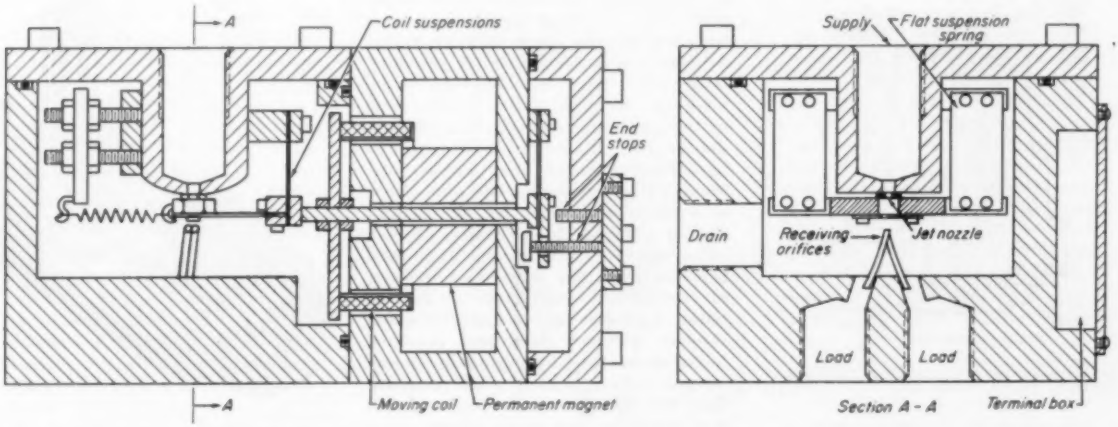



**FIG. 8. JET-PLATE SERVOVALVE** using suspension principle of Fig. 6. Moving coil is suspended between two leaf springs. A third leaf spring connects jet-plate to coil.

# Using instrumentation

● By S. H. ISAACS, *President, The Isaacs Company, Cincinnati, Ohio*

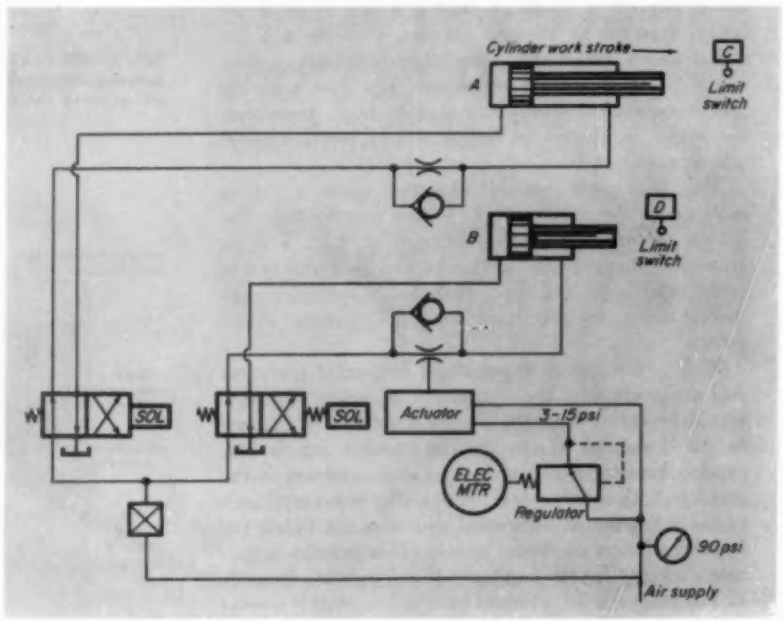
*When it comes to fine control requiring feedback, designers of fluid power systems can take some lessons from chemical processing*

### *Synchronizing Cylinders at the End of Their Strokes*

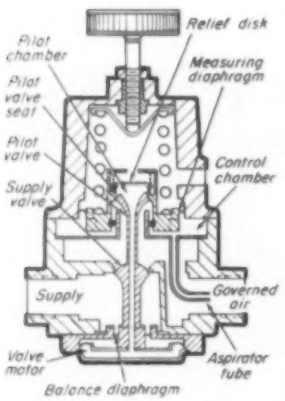
Two cylinders, *A* and *B*, of different strokes, start at different times, but must complete their strokes and close their respective limit switches, *C* and *D*, at the same instant. The cylinders are then quickly retracted and the cycle repeated.

Should cylinder *A* complete its stroke first, limit switch *C* is actuated before limit switch *D*. This energizes the regulator motor to increase the regulator's output pressure. Higher pressure causes the actuator to open the flow control valve slightly, and thus increase speed of cylinder *B*. Conversely, should cylinder *B* close its limit switch first, the flow control valve of cylinder *B* will close slightly, and slow the cylinder speed.

The correction of cylinder speed is effective on the next cycle to synchronize cylinder action. When the two limit switches are both open or closed, the regulator output pressure and actuator setting remain constant.

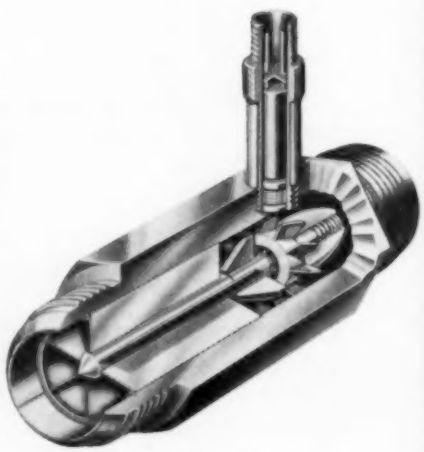



**TWO UNEQUAL LENGTH CYLINDERS** are controlled to start at different times and to reach the end of their strokes together.




*Courtesy Stratos Div., Fairchild Engine & Airplane Corp.*

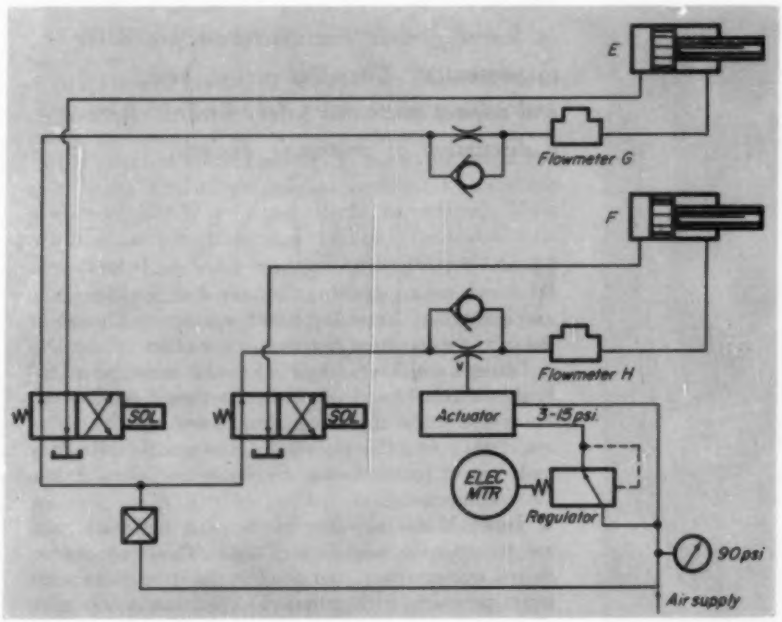
**BALANCED VALVE DESIGN of pressure regulator permits supply air to act on equal areas of supply valve and balance diaphragm. Regulated air pressure acts through aspirator tube on measuring diaphragm and is counterbalanced by range spring to push down pilot valve, opening supply valve and reducing pressure drop through valve. An increase in regulated air pressure raises pilot valve seat, bleeding regulated air through hollow valve stem to the underside of large valve motor diaphragm. This pushes valve stem up, increasing pressure drop across supply valve and reseating the pilot valve at equilibrium. Pilot air flows only during change in pressure. Relief valve operates on excess, regulated pressure when the pilot valve is open to re-establish equilibrium at the set point. Aspirator tube compensates for velocity pressure drop and pressure losses in downstream piping. Its downstream end is located when increase flow results in lower pressure in control chamber. This opens supply valve to give compensating rising pressure characteristics.**



*Courtesy Cox Instruments Div. George L. Nankervis Co.*

# to control fluid power

*and petroleum refining. These two circuits show applications of 3 to 15-psi instrumentation to feedback systems for speed control.*

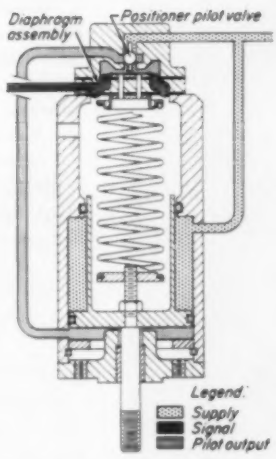



### *Synchronizing Cylinders During Their Strokes*

In this circuit cylinders must travel at identical speeds throughout their strokes. Correction must be instantaneous and continuous. Flowmeter *G* and *H* are accurate to 0.5% of instantaneous reading. Flow through the meters is proportional to cylinder speed. Their electrical outputs are fed into a frequency converter. Should one cylinder move faster than the other, electrical output from the corresponding flowmeter will be greater, applying a signal to the converter. Current then flows from the converter to a sensitive galvanometer relay which signals the regulator motor. If cylinder *E* moves faster than cylinder *F*, the motor increases the regulator output pressure. This causes the actuator to open slightly and increase the speed of cylinder *F*. Conversely, should cylinder *F* move faster, the opposite action would take place, and its speed would be throttled. Any difference in cylinder speeds is relayed as an error and corrected instantaneously during the stroke. ▼▼▼

**TWO EQUAL LENGTH CYLINDERS** are instrumented to travel together and at identical speed throughout their strokes.

**TURBINE FLOWMETER mounts directly in the line. When fluid passes through the turbine, the turbine revolves at a speed directly proportional to fluid velocity. As each turbine blade passes the pick up, it breaks the coil's magnetic field and produces an a-c signal. Since rotational turbine wheel speed is proportional quency is proportional to the flow rate. Flowmeter accuracy (linear frequency output) is 0.5% of any reading over the instrument range. Repeatability accuracy is 0.2%. The flowmeter output is a high frequency signal which results in high resolution, especially when used with a counting type indicator. Signal strength is at least 30 millivolts at minimum rated flow. The normal frequency range can be altered to match available indicating equipment.**

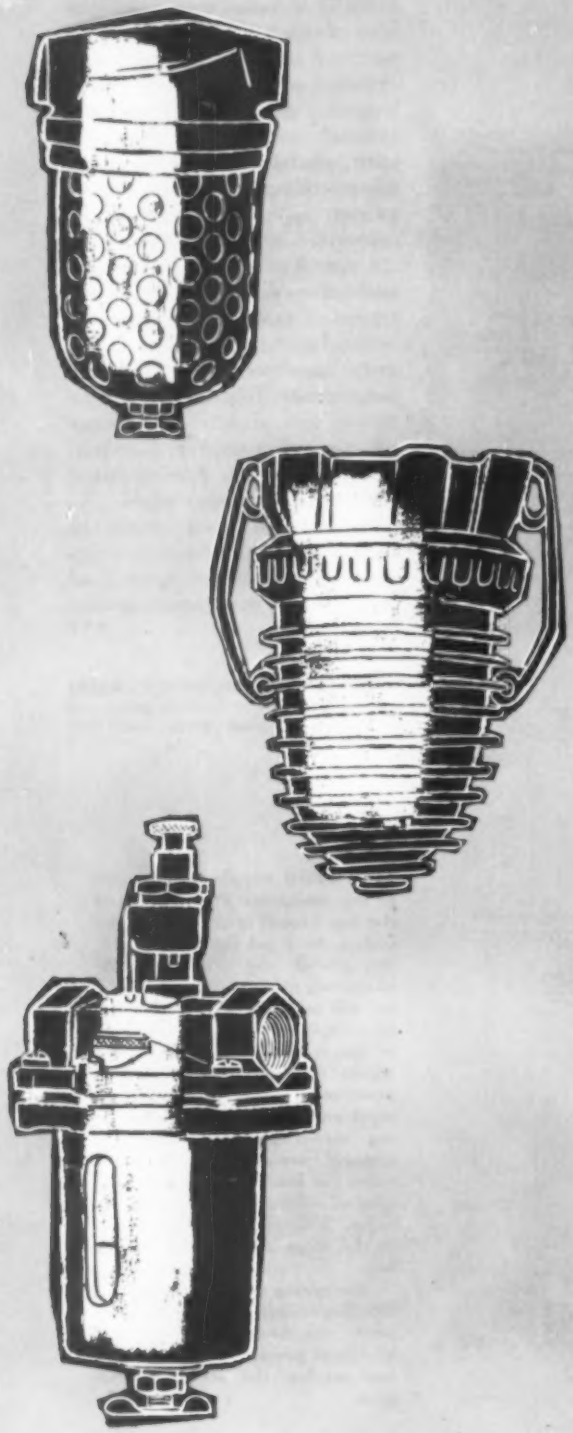



*Courtesy The Annin Co.*

**ACTUATOR supply air is piped to the positioner pilot valve and the top (small area) side of the piston. At 1 psi signal pressure, the piston rod will be fully extended, and the positioner pilot will be fully closed, blocking air supply to the large area side of the piston. As the instrument signal increases, net force on positioner diaphragm is downward and increases with increasing signal pressure. The diaphragm assembly moves down when the rate spring force is exceeded opening the positioner valve. This connects supply air to the large area side of the piston.**

**The spring compresses against the diaphragm assembly and balances the downward force due to signal pressure when the piston reaches the required position.**

# Protecting air lubricator . . . *what*



*If you've been troubled by breakage of air filter and lubricator bowls, you'll be interested in learning what manufacturers are doing to prevent it. Chemical action, heat, and impact cause this safety hazard. Here is a discussion of protective designs.*

MANUFACTURERS of air filter and lubricator bowls are recognizing the hazard of bowl breakage and are taking steps to protect against it. Though it doesn't happen often, just once is *too* often.

Transparent bowls show when oil must be added to the lubricator and when the filter must be drained. Many materials, including glass, have been tested to see if they had the visibility feature with the safety and cost of plastic bowls. So far, glass is too brittle and too expensive.

• **Bowl Material**—One of the first materials used for transparent bowls was Lucite. This had the required transparency, and good *initial* strength to withstand pressures higher than 150 psi, but it was soon discovered that Lucite fatigues and loses its initial strength. Most manufacturers now use acrylonitrile styrene for transparent bowls. It has good initial strength without any apparent tendency to fatigue. It also has good chemical resistance, and high modulus of elasticity.

Manufacturers are alert to new materials as they are formulated. They're testing every imaginable material which suggests it could be suitable, even those available only in test batches. There still is no ideal material. They have also experimented with linings and coatings to improve chemical resistance, but without success.

Metal bowls, usually brass, steel, or aluminum, and often interchangeable with transparent plastic bowls, are recommended for:

a. Operation near furnaces, compressors, or forging presses where temperatures go above 120 F.
b. Atmospheres containing chemical fumes, paint solutions, degreasing fluids, and cleaning solvents, etc. which would attack plastic bowls.
c. High vibration or other physical abuse.
d. Higher pressures.

• **Bowl Performance Requirements**—Pressure rating of a bowl depends on its design and is limited

# and filter bowls

## *manufacturers are doing for safety*

by long-time creep, and stresses set up by the bowl retainer. With some minor variations, standard ratings are 125 psi to 150 psi at 120 to 125 F. Safety factors range from 4:1 for large bowls to 15:1 for small ones.

Acrylonitrile styrene is stronger at lower temperatures, so a bowl with the above rating can be used safely at higher pressures if temperature is reduced. But it requires some figuring to know just what the safe limits are. Conversely if ambient temperature goes over 120 F, pressure should be reduced. Most manufacturers recommend metal bowls for higher temperatures.

• **Quality Control**—Safety starts in the manufacturer's production line with good molding techniques and quality control. Bowl design is important to avoid locked-in strains which can also be caused by the molding process. Quality control is one of the major keys to reliable bowl performance.

Quality of standard plastic bowls is very carefully maintained. Raw materials are checked for proper analysis, molding cycles and temperatures are checked. After molding, some bowls are furnace annealed to reduce molding strains. Sample bowls are tested for stress craze.

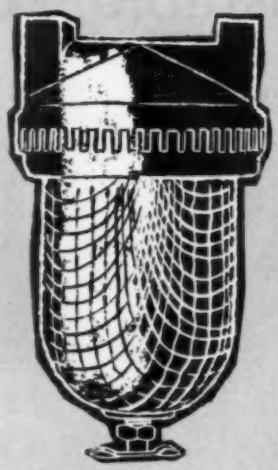
One manufacturer, producing bowls by injection molding, runs hydrostatic tests on random samples from each molding batch. With a rating of 150 psi, minimum acceptable pressure is 850 psi. If two or three bowls burst at less than this, the entire batch is rejected. Almost all bowls tested do not rupture until 1200 or 1300 psi, and in some cases the bowls withstand 1800 psi.

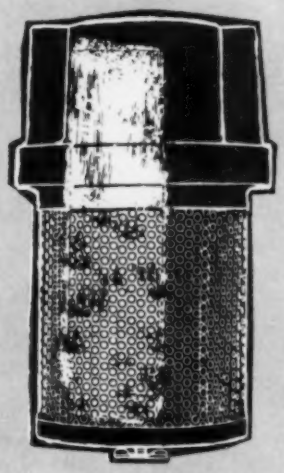
Another manufacturer bursts a sample from each batch then uses rules of statistics to calculate the lowest burst rate expected in that lot. If this figures out to less than 1000 psi, he rejects the entire lot, or inspects it 100%.

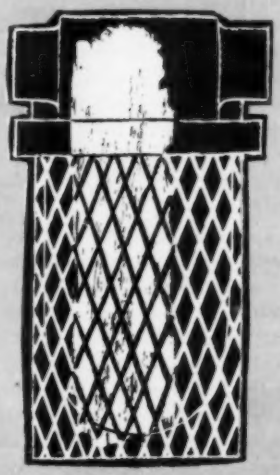
• **Why Breakage?**—Poor application is the big reason. Plastic bowls are installed where ambient temperature is too high. They're mounted in places where they can be hit by passing trucks. They're used in chemical atmospheres which attack them. Good application practice is part of the answer to bowl breakage, but manufacturers are also coming up with ways to protect against this hazard.

One of the newer problems that plastic bowls have to cope with is fire-resistant, compressor lubricants. Phosphate ester lubricants can carry hundreds of feet down the air line from the compressor, and in one

Continued on page 80

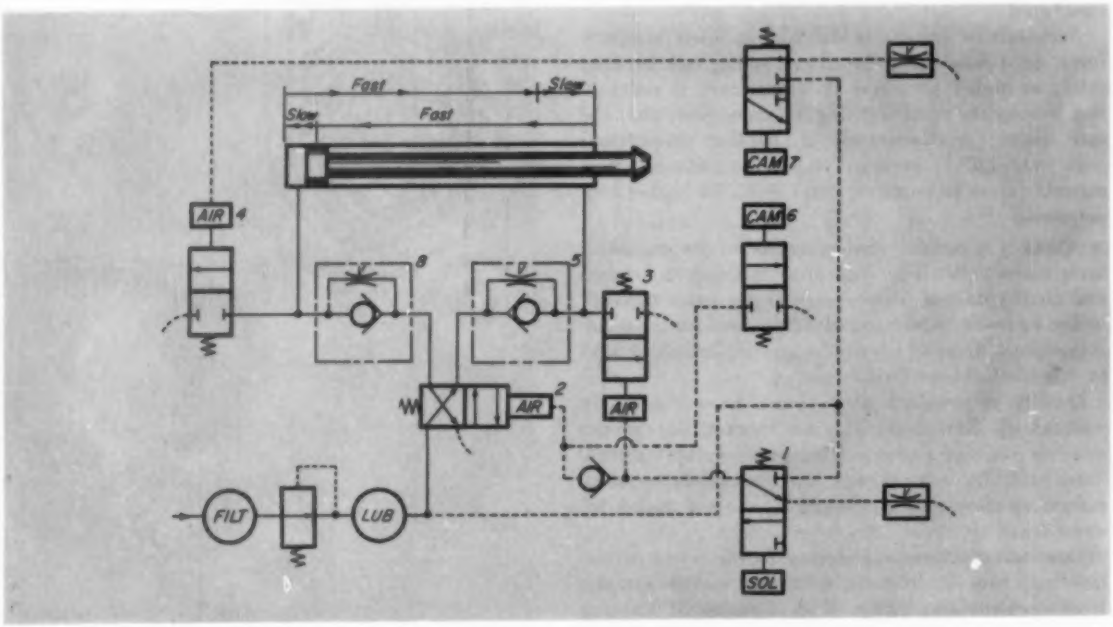






# Adjustable external cushioning

• By **W. C. THOMPSON,** *Hannifin Div., Parker-Hannifin Corp., Des Plaines, Ill.*




STANDARD air cylinder cushions won't work with high inertia loads or fast piston speeds. You may have to use external cushions. Here's a circuit that gives a double-acting air cylinder adjustable cushioning at both ends of its stroke.

• **Operation**—Air is piped to the circuit through a filter, regulator, and lubricator. To extend the cylinder, 3-way pilot solenoid valve 1 is momentarily energized. Pilot air flows to the actuator on the 4-way control valve and shifts it to extend the cylinder. Pilot air also shifts valve 3 allowing exhaust air from the cylinder to bypass the flow control valve 7. The cylinder extends fast.

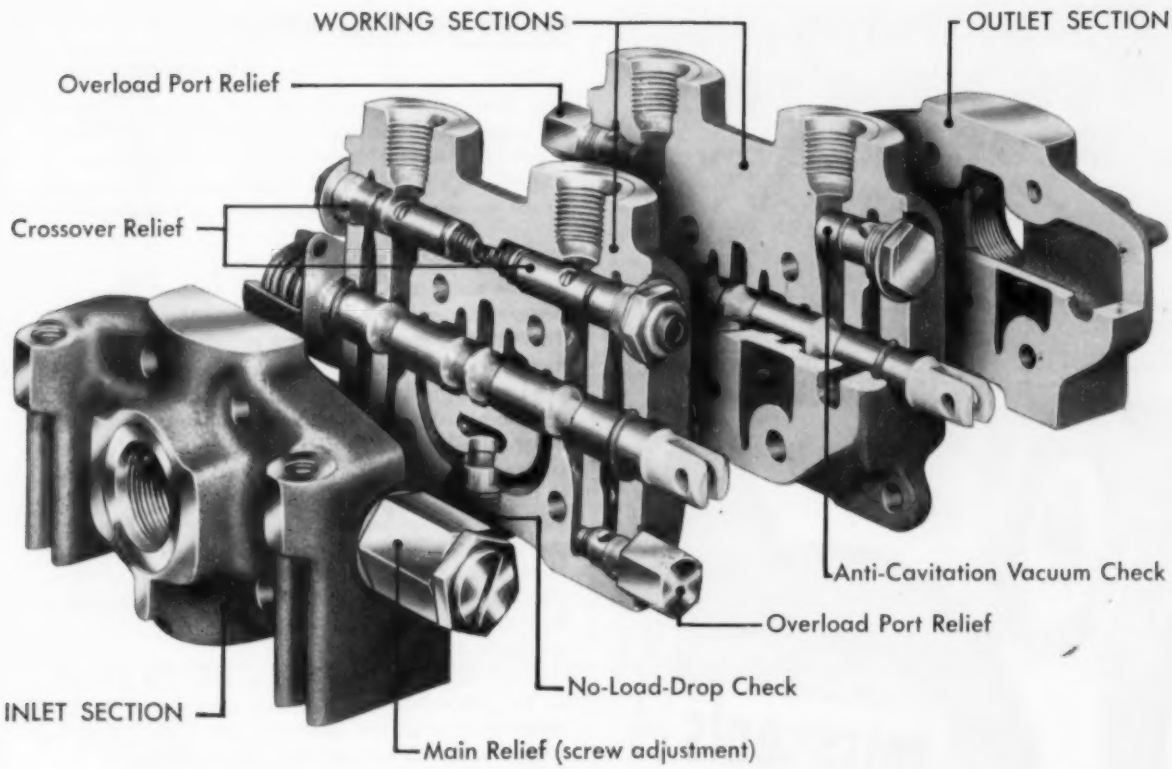
As soon as valve 1 de-energizes, air from the actuator on valve 3 bleeds off slowly through the flow control valve at the exhaust from valve 1. Bleed rate is controlled by setting the flow control valve. The check valve holds air pressure in the actuator on the 4-way control valve.

When pressure to the actuator on valve 3 drops to 10 psi, the valve shifts. Air from the rod end of the cylinder then meters out through flow control valve 5. The remaining stroke is at slow speed, regulated by the setting of valve 5.

At or near the end of the stroke the two cam operated valves are actuated. Valve 6 exhausts air from the actuator on the 4-way valve. The valve shifts and air flows into the rod end of the cylinder. Cam-operated valve 7 directs air to the actuator on the 2-way valve 4. It shifts and allows exhaust air from the head end of the cylinder to bypass flow control valve 8. The cylinder retracts fast.

When the cam rides off valve 7, air bleeds out of the actuator on valve 4. Bleed rate is governed by setting the flow control valve at the exhaust from the cam-operated valve. When actuator pressure in valve 4 falls to 10 psi the valve shifts. Air from the head end of the cylinder then flows through the flow control valve 8 and exhausts through the 4-way valve. The cylinder retracts slower and comes to a stop at the end of its stroke. To repeat the cycle, valve 1 is momentarily energized again.

The valve-actuating cam should be as short as possible since timing control of valve 3 does not start until the cam rides off of the actuator on the cam-operated valves. ▼▼▼




# Only 12 psi drop in new 2000 psi valve

## For earth moving, mining, materials handling, agriculture and ground support equipment

COMMERCIAL Model A, series 20 and 35 manually operated parallel circuit valves directionally control fluid power up to 2000 psi. Internal pressure drop has been reduced at least 50% compared to earlier models. Back pressure in the exploded A20 valve, illustrated, having two working sections, is only 12 psi at 20 gpm through flow—all spools neutral. Under same conditions, valve having six working sections records back pressure of only 33 psi. Performance of the A35 valve is equally outstanding. Complete, all-condition performance ratings are available—proving quite revealing.

**Exclusive Easy Access Features**

- MAIN RELIEF VALVE controls system relief pressure—circuit loaded
- NO-LOAD-DROP CHECK blocks pressurized return flow
- FLOW RESISTOR CHECK controls rate of cylinder movement
- OVERLOAD PORT RELIEF prevents pressure build-up beyond port—spool neutral
- ANTI-CAVITATION VACUUM CHECK releases vacuum build-up in cylinder
- CROSSOVER RELIEF protects against shock load—spool neutral

**Smooth, Precise Operation**—COMMERCIAL's new, rugged, heavy-duty valves eliminate jerky, erratic movements of equipment common to ordinary valving. Highly sensitive and positive is their action. Just "velvet touch", finger tip, spool operation meters the most precise and delicate flow. Feel of equipment motion actually "plays back" through the spool handle.

**Control Functions for All Needs**—Working sections can be assembled in tandem, in any sequence. Sections with 3, 4 or 5 spool positions are available with spring return or detented spool actions. Single acting, double acting, hold, float or regenerative actions are all available. Complete hydraulic system and equipment protection can be yours—built right into Model A valves—without external piping.

**Technical Service and Literature**—Experienced technical service and assistance is available from our factory-based personnel. Bulletin 100-P16 gives full data on the new Model A valves. Address: Commercial Shearing & Stamping Company, Dept. A-45, Youngstown 1, Ohio.

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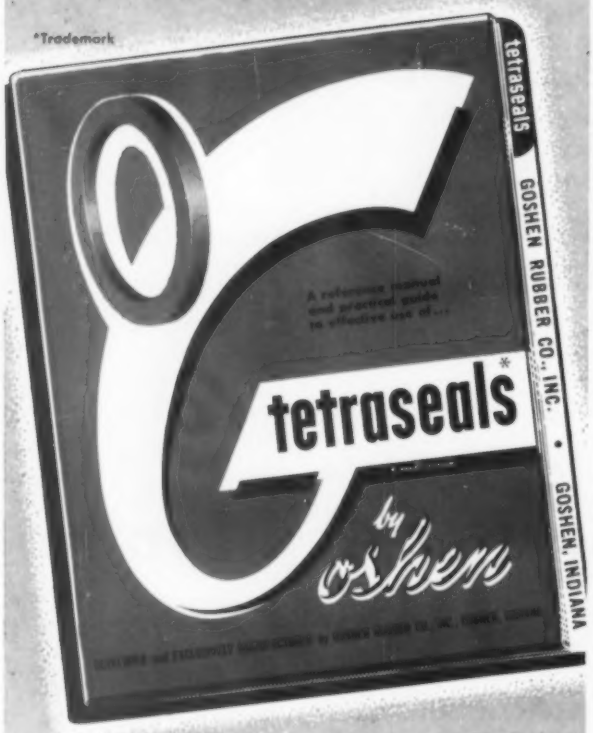


This 12-page brochure presents the story of the GRC Tetraseal . . . designed for direct o-ring substitution in most static, and some dynamic applications. Interchangeable with o-rings, size for size from 3/16" up to 15" ID, Tetraseals use the same groove as an o-ring, hold extremely close tolerances on cross section, ID and OD, and are made without joints or laminations. What's more, they offer money-saving advantages, in most cases.

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## PROTECTING FILTER BOWLS

Continued from page 78

case lubricant was traced with a fluorescent tracer to air components a half mile away from the compressor. Since fire-resistant lubricants are a safety feature in themselves, bowl materials—and in fact all materials in the pneumatic system—will have to be compatible.

• **Bowl Guards**—Three basic designs are being used to give visibility with protection. One of these is a perforated metal cover which fits over the plastic bowl. This protects the bowl against impact and retains the flying pieces if the bowl breaks. In one design the bowl cannot be removed and replaced without replacing the guard which is integral with the bowl clamp collar. One style of steel guard with ½" perforations is made from .036" sheet, zinc plated. It is deep drawn to the shape of the bowl and provides 50% visibility with 99.6% retention of plastic fragments. Two other guard designs protect against impact, and retain fragments in case of breakage. One of these is made from zinc-coated expanded steel which is rolled and welded to fit the bowl. The other is coiled steel wire with hooks to attach it to the piping.

In another protective design, a wire mesh is molded in the plastic bowl. This design provides an integral safety bowl with the necessary safety and visibility requirements for airline filters and lubricators.

This design prevents any fragments from leaving the bowl if the bowl breaks because of impact, excessive temperature, pressure, or chemical attack.

The third basic design combines the strength of a metal bowl with the visibility of a pyrex window. It has a die cast bowl in which a transparent window is inserted and sealed with a Buna-N O-ring. This approach to the safety problem means that a factory can standardize on one type of bowl.

The bowl can be used near heat, with any type of lubricant. Pressure can be as high as 250 psi or more. Solvents or steam used to clean off machinery will not affect the bowl. It can be rotated on installation so that the window is visible from any angle. ▼▼▼

*Editors of* HYDRAULICS & PNEUMATICS *wish to thank the following men for their assistance in preparing this article:*

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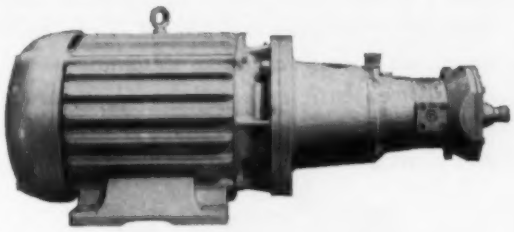
William B. Cornell, Manager Industrial Div., Watts Regulator Co., Lawrence, Mass.

Don W. Benner, General Sales Manager, Wilkerson Corp., Englewood, Colorado

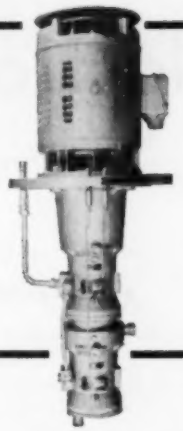
# 1

This is a Towler axial plunger oil pump, size A4, which discharges 14.8 cu. ins/sec. up to 5500 psi. at 1730 rpm. It can be supplied motorised as shown.



# 2

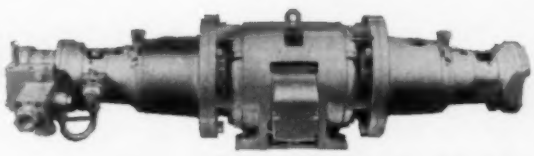
Two axial pumps can be mounted in tandem, one driven through the other. This example shows a motorised size A4TA4 pump fitted to a tank mounting flange, ready to drop into a tank (which is supplied if required)



# 3

A vane pump (L Series) is available built onto the axial pump. In this example the vane pump is fitted with a relief and unloading valve. From right to left, the combination shown here is A1CL-Motor-A4L96.

Vane pump discharges, up to 1000 psi, are 25, 41 cu. ins/sec. at 1730 rpm. and 49,77 cu. ins./sec. at 1150 rpm.



# 4

Towler axial pumps are available with discharges (Series A) up to 22.2 cu. ins/sec. at 5500 psi. at 1730 rpm; or (Series XA) 14.8 cu. ins./sec. at 9000 psi. 1730 rpm. They are also available for face and foot mounting, packaged in or on a tank; there is a full range of valves, and excellent high pressure system design service is available.

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*Part 1 of this series which appeared in June discussed types of servovalves and what they can do. Part 2 in August reviewed important considerations in designing servosystems and showed basic applications. This concluding article tells design requirements of five specific machines and describes how servo systems were designed to meet them.*

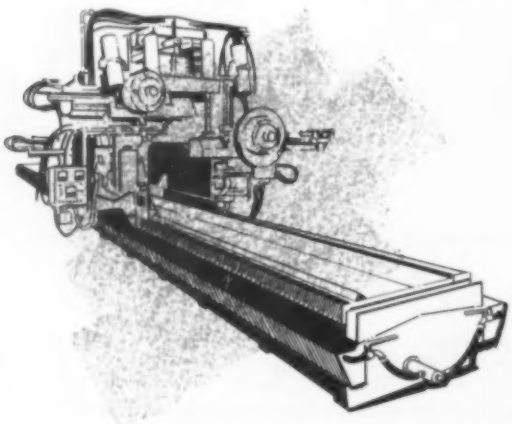
# Electrohydraulic servovalves in industry

• By **HARVARD B. KOLM,** *Manager, Industrial Division, Moog Servocontrols, East Aurora, N. Y.*

## PART 3 - FIVE CASE HISTORIES

### SPAR MILL TRACER

• **Control Requirements**—The requirement of a moving carriage, spar milling machine was for a flexible tracer control on the vertical axes of double cutting heads. The transverse or cross-wise tracing control was mechanical but this design was not suitable for the vertical axis.



Geometrical limitations imposed by a mechanical tracer system using unity mechanical feedback could not be tolerated. Accuracy and repeatability had to be better than conventional mechanical tracer systems.

• **System Design**—Because of these requirements, an electrohydraulic control system was selected for each vertical axis tracer control. Each system has an electrical transducer to detect displacement of an input cam driven from the longitudinal carriage motion axis. Electrical output from the transducer is compared to output from a transducer sensing vertical head position. The amplified error drives the servovalve.

The reflected inertia of the head in the vertical axis represents about 5000 lb mass. There is also about 2000 lb of friction in the vertical ways. The total vertical stroke is 6 in. The electrohydraulic tracer system has a repeatability in the order of .0005 in. with an aluminum workpiece and .001 in. to .0015 in. repeatability with steel. The overall accuracy from cam or template input to workpiece is in the order of .005 in. to .006 in. At a carriage velocity of 40 ipm, velocity error is less than .0006 in. on a 45-degree ramp on the vertical axis.

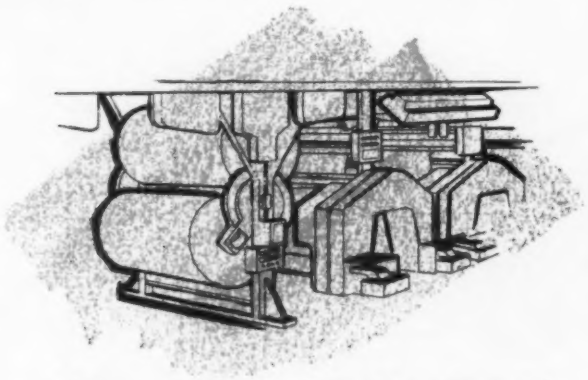
In addition to good repeatability and flexibility, input cam displacement can be five to six times greater than required output displacement. Electrical transducers make it much easier to prepare cams because accuracy required in preparation can be five or six times greater than that required on the output workpiece. The ease of selecting a scale with electrical instruments eliminates a 1:1 displacement relationship between input and output.

Flexibility of the electrohydraulic tracer control system permits putting the input cam mechanism on one side of the machine away from the cutting head vertical slides and cylinders. This type of machine has a carriage about 100 ft. long.

## PRINTING PRESS STEERING

• **Control Requirements**—Paper must be accurately fed into high speed, printing presses. Moisture variations in a roll of paper and inaccuracies in the spool make the paper run off on one side or the other. The corrective action to keep the paper running straight must have high response to keep down waste. A severe disturbance occurs when one roll runs out, and paper from a different roll is spliced on. Misalignment at the splice may be in the order of ±1 to 2 in.

• **System Design**—A high response, electrohydraulic control system meets these requirements very successfully. A photoelectric device detects the paper's edge position as it enters the press. Errors in edge position detected by the photoelectric device create a driving signal for a position servomechanism which moves a steering roller placed between the paper roll and the entry of the printing press. The steering system has an electronic amplifier package, servovalve, hydraulic cylinder, and hydraulic power supply, in addition to the photoelectric sensing device.



The electronic package, hydraulic power supply, and servovalve are usually packaged together and mounted near the steering roller cylinder. The cylinder moves only about 1/32 in. during normal operation. The electrohydraulic servo for this application gives much greater speed than any other method and permitted maximum press speed.

## AUTOMATIC CART STEERING

• **Control Requirements**—Automatically guided carts or trucks for warehousing operations are a recent development in the materials handling field. These have a sensing element which tracks an electrically excited wire embedded in the floor. Heavily loaded, large trucks require high torque for positioning the steering axle. Also, the steering must have high response according to vehicle velocity. The wire sets up a magnetic field which is tracked by the guidance head. Additional signals are superimposed on the magnetic field for programmed stopping and turning.

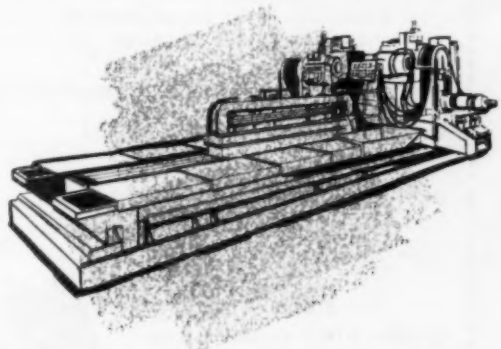
• **System Design**—Electrical, position error signals from the steering head control flow from a servovalve to a cylinder attached to the steering axle.

By steering the axle to keep the detected error signal at zero, the magnetic field is tracked accurately. One automatically guided cart has been in operation for several years.

## CONTOUR CAVITY MILL

• **Control Requirements**—A large duplex cavity mill requires independent control for each of two cutting heads, one on each side of the workpiece. The head is programmed from a template or from a pencil type input. The machine is the first of its type designed to mill ferrous as well as non-ferrous metals. It has the weight, rigidity, and low feeds to mill high alloy steels. Each spindle is driven by a 60-hp, adjustable speed, d-c motor which gives a cutting speed range of 15 to 3600 rpm with four mechanical speed changes.

The machine has a work table and two, opposed, traveling column, milling units. Each column carries a head saddle, which travels on a vertical slide. Both head saddles carry horizontal milling heads on a horizontal slide for in-out, or depth travel. The two milling units are used independently under either manual or template control.



• **System Design**—Electrohydraulic servos are used

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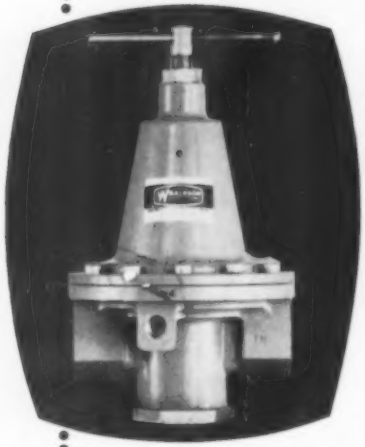

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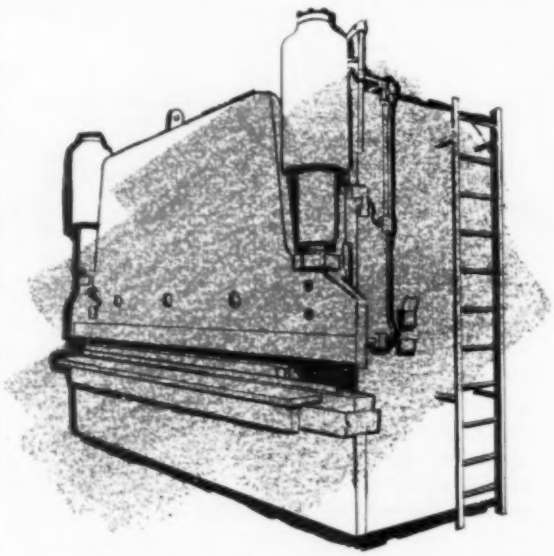
## ELECTROHYDRAULIC SERVOVALVES

for each of the two head positioning systems. Each head has 3-axis control over a bed stroke of 100 in., 40-in. vertical travel and 24-in. depth. Accuracy and repeatability in each of three axes is ±0.001 in. Cutting rates range to 100 ipm.

### PRESS BRAKE TILT

• **Control Requirements**—Hydraulically operated press brakes have a cylinder on each end of a bending die. When the bending die is loaded unsymmetrically, the two cylinders must be synchronized to keep the die from cocking.

• **System Design**—In the control system, a metal tape mounted on the die actuates a linear variable differential transformer (LVDT) to generate a signal



if the die tilts. A special, 3-stage electrohydraulic servovalve holds tilt within a small tolerance under the extreme condition of a steel block placed directly under only one of the cylinders.

An error signal produced by the LVDT is amplified and applied to a special, open-center, flow control valve which acts as a flow divider to control flow to each of the cylinders.

The press brake has a dual hydraulic system. The primary hydraulic system which actuates the press cylinders operates at maximum pressure of 2000 psi. The secondary supply for the first two stages of the servovalve, operates at 1000 psi and is filtered to less than 10 microns.

With a 10-ft. bending die weighing approximately 5000 lb., having rated load on one end of the die, tile errors are less than ±0.002 in. per foot of die length. Total stroke is approximately 2-½ ft. Repeatability is 0.0005 in. per ft. A fully mechanical system can achieve approximately the same results with a mechanical input to the servovalve. ▼▼▼

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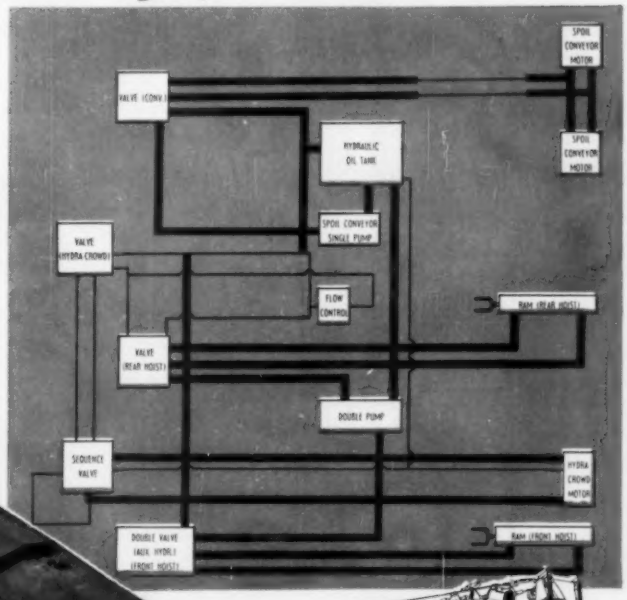
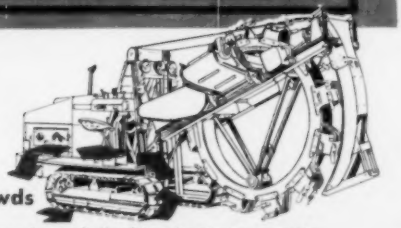
# with Gates Hydraulic Hose



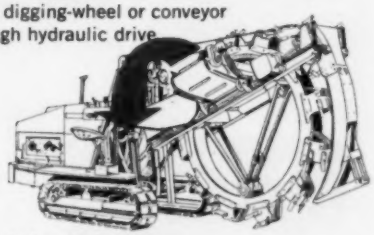
**Digs**

with maximum efficiency — thanks to exclusive Hydra-Crowd hydraulic transmission.



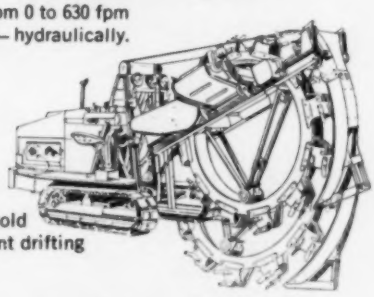
**Crowds**

independent of digging-wheel or conveyor speeds — through hydraulic drive.



**Conveys**

at variable speeds from 0 to 630 fpm with instant reverse — hydraulically.



**Hoists**

swiftly, positively to hold accurate grade, prevent drifting — hydraulically.

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Of the Gates Hydraulic Hose used on the Model 772 Wheel Ditcher, Barber-Greene engineers have said: "Gates Hydraulic Hoses meet all of our rigid engineering specifications, and have operated to our satisfaction under the difficult conditions encountered in trenching work."

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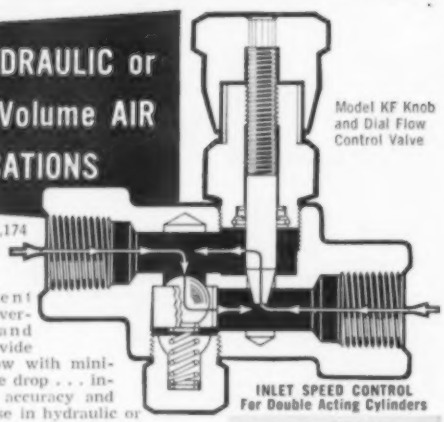
# AUTO-PONENT® VALVES | FLOW CONTROL, NEEDLE, CHECK

## For HYDRAULIC or Large Volume AIR APPLICATIONS

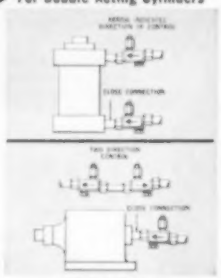
Patent #2,841,174



Model KF Knob and Dial Flow Control Valve

Auto-Ponent Valves with oversize ports and passages provide maximum flow with minimum pressure drop . . . insure greater accuracy and quick response in hydraulic or large volume air cylinder control. Self-aligning needle has unique Quad-Ring gland seal located at pressure port to seal off threads in needle housing, allowing needle to turn easily under maximum pressures. Gland structure and location also prevents air or dirt trapping in the housing. Flow Control and Check Valves have sensitive, chatterless ball check. Patented design insures rapid ball movement to open or close fully at low differentials. Made in 5 female Dryseal pipe sizes from $\frac{1}{8}$" to $\frac{3}{4}$" inclusive. 3 Models: Standard, Knob and Dial, and Panel Mounting. Valve bodies are forged aluminum (3000 psi), steel or stainless steel (5000 psi). All internal parts are Stainless. Typical applications shown at right. Write for catalog AP59.

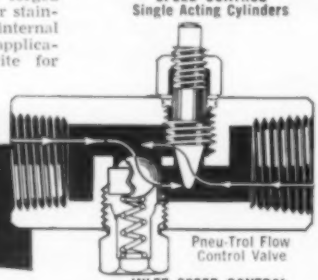
INLET SPEED CONTROL
For Double Acting Cylinders



SPEED CONTROL
Single Acting Cylinders

## For AIR APPLICATIONS

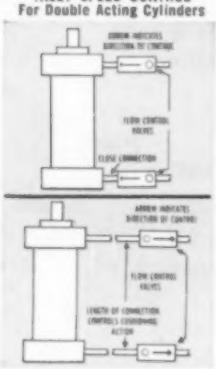
Patent #2,811,174



Pneu-Trol Flow Control Valve

INLET SPEED CONTROL
For Double Acting Cylinders

Pneu-Trol Flow Control, Needle, and Check Valves are widely used for air or small volume hydraulic cylinder control. Extremely compact design permits consolidated piping arrangements. Long tapered needle provides very sensitive and accurate air or oil flow control. Sensitive floating ball check opens or closes fully at slightest differentials. Valve bodies are machined from solid hexagon bars of aluminum or brass (2000 psi) steel and stainless steel (5000 psi). All internal parts are stainless steel. Made in 5 female Dryseal female pipe sizes: $\frac{1}{8}$" to $\frac{3}{4}$" inclusive. Typical applications of Pneu-Trol Flow Control Valves are shown at right. Write for Pneu-Trol Valve Catalog No. 22.



EXHAUST SPEED CONTROL
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## PRINCIPLES OF SERVOVALVES

Continued from page 73

coarse adjustment to zero the valve. For fine adjustment, a potentiometer mounted in the terminal box is connected in the coil circuit. Suppose the jet nozzle is to be in its center position with a 3 ma. signal. The potentiometer permits shifting this signal applied to the moving coils from, say 2.8 to 3.0 ma. The coil spring is then used to center the jet nozzle approximately. The potentiometer adjustment takes care of the rest.

Adjustable end stops for the coil limit jet-nozzle motion to the distance corresponding to maximum recovery pressures in the two receiving orifices. These stops are adjusted from the outside after removing a sealing cap. The table shows typical sizes for this servovalve design.

***Jet-Plate Servovalve Characteristics***

| Size | Flow—gpm 100 psi | 400 psi | 1000 psi | Diameter of smallest flow passage Inches | Microns |
|---|---|---|---|---|---|
| A | 0.4 | 0.8 | 1.3 | 0.040 | 1000 |
| B | 0.8 | 1.6 | 2.5 | 0.055 | 1375 |
| C | 1.8 | 3.6 | 5.7 | 0.081 | 2025 |

This single-stage, jet-nozzle servovalve has minimum flow turbulence. It eliminates practically all danger from clogging by dirt particles. It has practically no friction, and therefore has high resolution sensitivity. Its moving elements have low mass. Cost is considerably reduced below any available, comparable servovalve. ▼▼▼

Recent articles on servovalves and servo systems which have appeared in HYDRAULICS & PNEUMATICS include:

**Hydraulic Servo Performance in Numerically Controlled Machine Tools**
By F. J. Cizek — June '60

**Electrohydraulic Servovalves in Industry**
By Harvard B. Kolm — Part 1 June '60; Part 2 August '60; Part 3 Nov. '60

**How Temperature Affects Hydraulic Servo Performance**
By August S. Lermer — June '60

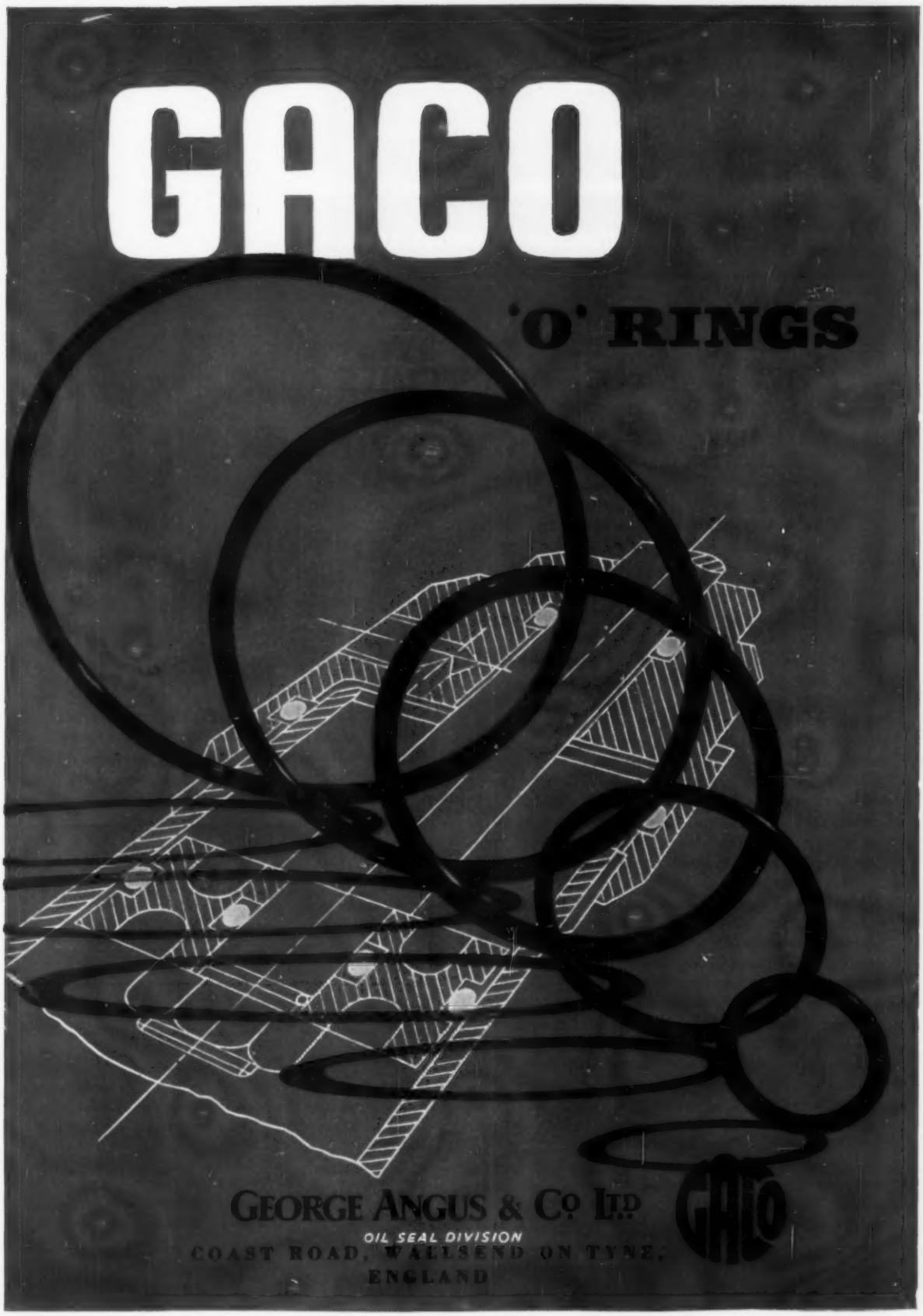
**Accumulator System Supplies Six Servo Valves for Welding**
By John H. Brems — June '59

**How a Load Sensitive Flight Control System Works**
By John Burnett and Don Moses — April '59

**Operation of Autopilot Servo Actuators**
By Richard K. Smyth — March '59

**What You Can Get in Electrohydraulic Servovalves**
By Wayne Kinney and Phillip Weiss — Feb. '59

**How Contamination Affects Servo Valve Design**
By Richard E. Osgood — Feb. '59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## APPLYING ELECTRICAL CONTROLS

PART 1 - Why solenoids burn out - JUNE 1960

PART 2 - Sequence malfunctions - AUGUST 1960

# Part 3 - Relay circuits and limit switches

• By D. FITZPATRICK, *Engineering Department, Allen-Bradley Co., Milwaukee, Wisconsin*

ELECTROHYDRAULIC control systems frequently use many relays. There are usually at least as many relays on a machine as there are solenoid operated valves. Some have only one or two normally open or normally closed contacts. Others have as many as twelve or more.

What are some of the problems relay users face?

One of the most common troubles is the lack of contact continuity. This becomes apparent when a relay is mechanically closed, but fails to pass current. The annoying consequences are obvious.

What causes the break of current flow? The culprit is often contact contamination. It happens when a non-conduction film is deposited on the contacts in certain prevalent environments. For example, atmospheric conditions containing a high concentration of sulphur, form a silver sulphide film which is a very poor conductor. In addition to non-conductive films, dirt on contacts obviously will keep them from closing and will stop current flow.

Though a number of reliability tests have been conducted by various relay users, they have so far proven inconclusive in determining what commonly causes relay failures. The following pointers are offered to help locate possible trouble spots.

• **Limit the Number of Contacts**—In a contamination—free environment, relay contacts initially require about three volts across them to establish current flow. This voltage virtually disappears once current has started to flow. It is recommended that not more than 10 double break contacts be connected in series in any branch of a control circuit. Experience shows this to be a satisfactory maximum figure.

• **Keep All Relays Active**—The circuit should be designed so that each relay operates once every machine cycle. Troublesome relays are often those that remain mechanically inactive, or unused, over long periods of time. If the electrical load on the relay contact is small, it is advisable to use a dummy load, so that a reasonable current is made and interrupted.

**WHAT CAUSES ELECTRICAL FAILURES?**

Maintenance records generally agree that electrical failures can be traced to the following components in the proportions shown:

| | | | |
|---|---|---|---|
| Limit switches | 50% | Valve Solenoids | 40% |
| Relays | 5% | Miscellaneous | 5% |

• **Plan Periodic Voltage Checks**—Control circuit voltage should be checked regularly. Voltages that exceed NEMA ratings can reduce a relay's mechanical life. Too low a voltage may aggravate the continuity problem.

• **Use Proper Enclosures**—Correct enclosures for atmospheric conditions, will do more to increase the reliability and life of a relay controller than hermetically sealed individual relays. If necessary, relays should be housed in pressurized cabinets to insure

Continued on page 90

We've
joined . . .

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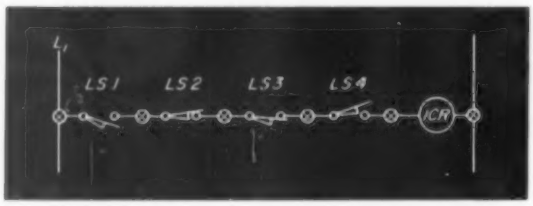
IMPERIAL EASTMAN

## APPLYING ELECTRICAL CONTROLS

Continued from page 88

optimum operating conditions. Where atmospheric contamination is less severe and Type 12 doors are used, they should be kept closed and tightly fastened down.

• **Relays and Downtime**—The general indication shows that relays actually cause relatively little difficulty, and it seems that in general, we should look elsewhere for ways to significantly improve system performance.




**LIMIT SWITCH** connections should be brought back to a terminal panel to facilitate trouble shooting and rewiring.

Maintenance records uniformly show that limit switches are responsible for about 50% of trouble calls and downtime, but usually the real trouble is not at all with the limit switch, but with its misuse, abuse, tampering, and misapplication.

If properly used, the compact, oiltight, commercially available limit switch could perform many more operations than the typical machine will impose upon it. But what really happens? Tampering and abuse. Springs are removed to decrease the necessary operating forces, and heavy tripping devices are allowed to strike against the switch. Furthermore, unreasonably long extensions and paddles are attached to the actuators, upsetting the switch dynamic balance, resulting in reverse overshooting and false operation.

There appeared, in the March 1958 issue of HYDRAULICS & PNEUMATICS Magazine, an article entitled: 8 *Rules for Using Limit Switches.* These rules outline proper design and recommended preventive maintenance practices. Most of these suggestions have since been incorporated into the Industrial Control Standards of the National Electrical Manufacturers Association. They are well worth studying and observing.

One final tip. Out of practical necessity, limit switches are often located in awkward, hard-to-reach places on a machine. It might, therefore, be helpful, to have each limit switch connection brought back to a terminal stud on an electrical control panel, when a number of switches are wired in series, (see illustration). This, of course, is not required for control or functional purposes, but as a troubleshooting or rewiring aid, such a connection may prove of inestimable value. ▼▼▼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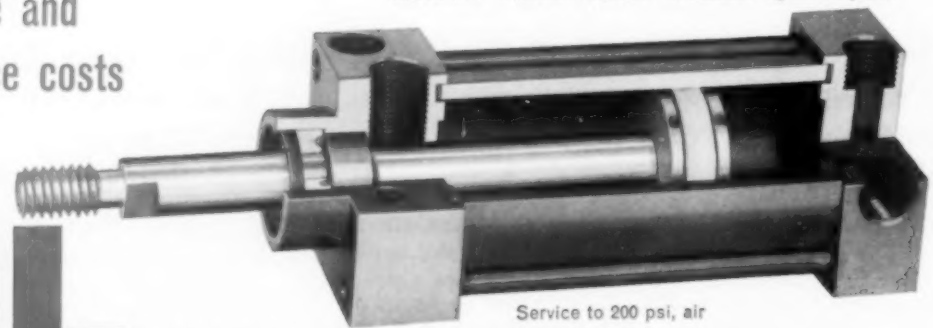
save space and maintenance costs

**Here's how your machines benefit** from the rigidity and machine-tool precision of Hydro-Line Series B cylinders:

- One-inch bore saves space, air, and maintenance costs on high-speed assembly machines and other applications in cramped quarters.
- Teflon rod seal-wiper combination and piston seal require no lubrication, have lowest coefficient of friction of any solid material, increase cylinder efficiency and reliability.
- Rod seal-wiper is removable without disassembling cylinder. Barrel seals are radially supported to insure leakproof seal compression.
- Choice of mountings for easy installation include front flange, rear flange, trunnion, clevis, and foot mountings.
- Immediate delivery from stock on ½, 1, 1½, 2, 2½, 3, 4, and 5-inch stroke cylinders, with stock cylinder discount. Custom strokes available upon request.



Service to 200 psi, air

HYDRO-LINE

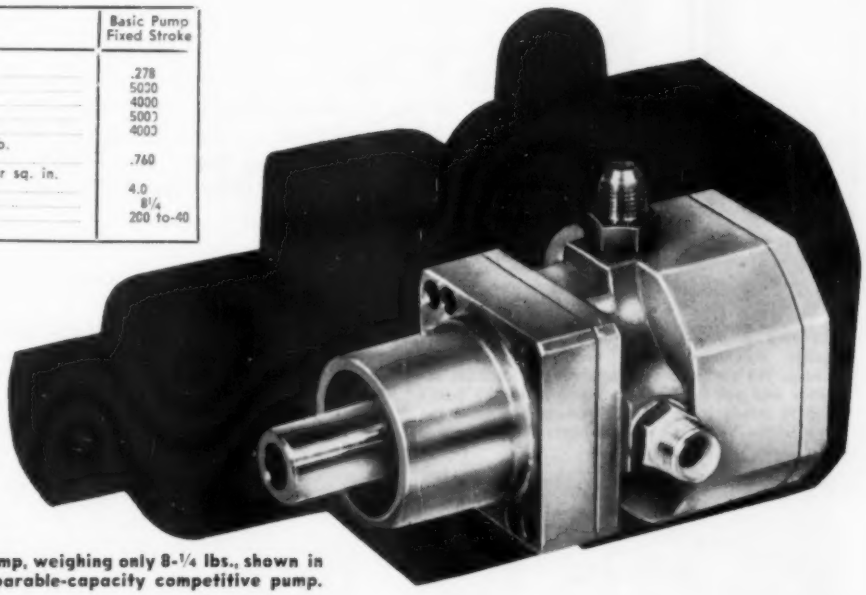
5601 PIKE ROAD, ROCKFORD, ILLINOIS, manufacturers of: high- and low-pressure hydraulic cylinders • heavy-duty air cylinders adjustable-stroke cylinders • dispensing cylinders • intensifiers • single-acting cylinders • booster cylinders • rod end couplers

# *new* LUCAS-ROTAX *industrial*

# HYDRAULIC PUMPS AND MOTORS

## offer the most advanced compact design

| PUMP DETAIL | Basic Pump Fixed Stroke |
|---|---|
| Fluid displacement (cub. ins./rev.) | .278 |
| Nominal working pressure (peak) (lb. per sq. in.) (continuous) | 5000 4000 |
| Nominal speed (peak) (r.p.m.) (continuous) | 5000 4000 |
| Input h.p. at 1,000 r.p.m. and 1,000 lb. per sq. in. differential | .760 |
| Max. Torque (lb./ft.) per 1,000 lb. per sq. in. fluid pressure differential | 4.0 |
| Weight (lb.) Basic Pump | 8¼ |
| Operating temperature, ° F | 200 to-40 |



**LUCAS-ROTAX IA4 pump, weighing only 8-¼ lbs., shown in comparison with comparable-capacity competitive pump.**

If you are interested in industrial hydraulic pumps or motors in the 1.5 to 108 g.p.m. range at pressures to 5000 p.s.i., you'll find more good design features in Lucas-Rotax pumps and motors than in any other quality line.

Lucas-Rotax industrial hydraulic pumps and motors are smaller and lighter than conventional units with low noise level in spite of high operating speeds. They offer fast response rate in pressure compensation and the low and medium capacity units can be operated from 2-pole motors to reduce the cost of the prime mover.

Pumps are available as variable volume, variable volume pressure compensated, overcentre cam (reversible) or fixed volume. Motors can be supplied in variable or fixed volume. Both pumps and motors deliver high performance with minimum maintenance. Available in quantity from domestic stock—call or write for technical data.

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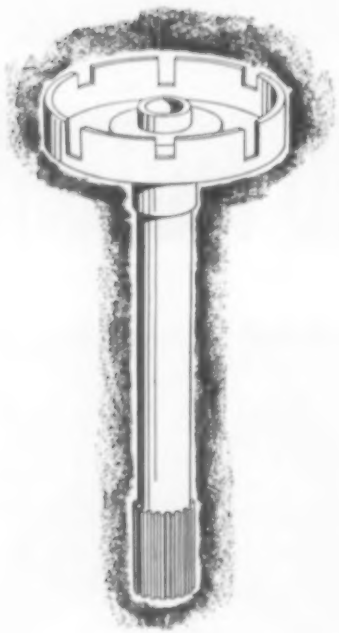
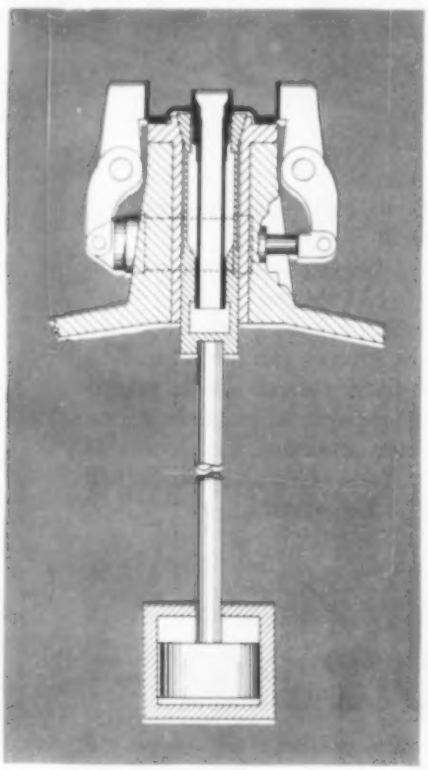


# How hydraulics helps machine this part

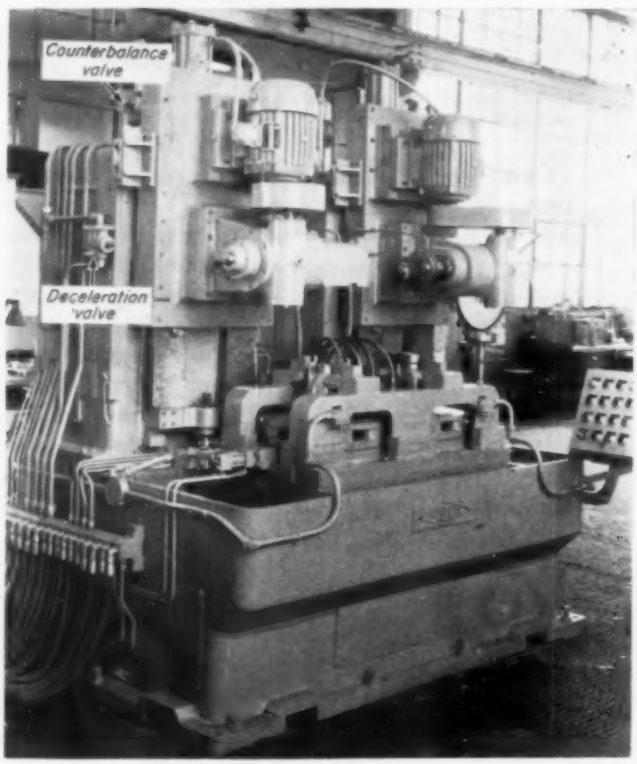
• By **FRANK J. BUCCI,** *Vice President, Engineering*
*The Producto Machine Co., Bridgeport, Conn.*

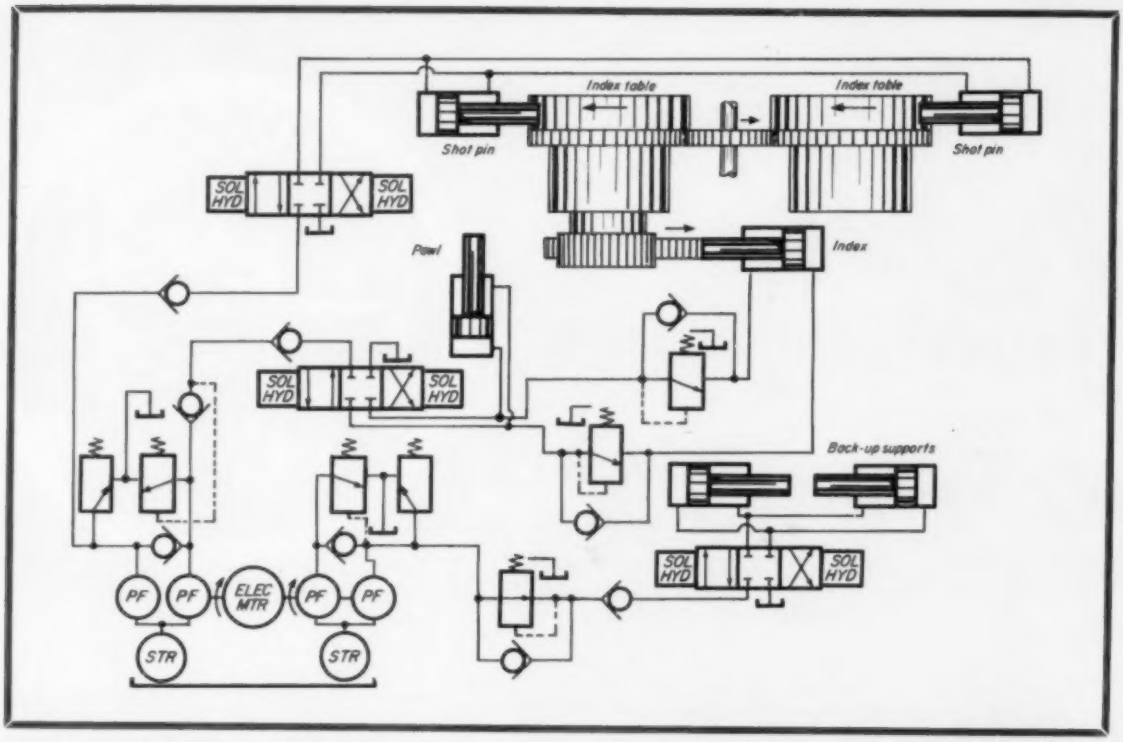
TO MILL six slots in this automotive transmission hub and shaft, Producto Machine developed this twin index milling machine. The slots are equally spaced within .001" of true angular position. Three of them are 5/16" deep spaced 120 degrees apart. The other three are 7/8" deep and spaced 120 degrees apart.

**CYLINDER ACTUATED COLLET** holds part during machining. After the vertical cylinder clamps the part, the smaller horizontal cylinder extends and applies back-up supports to the part's hub to steady it. A pressure reducing valve in the line to the back-up cylinders limits the force they can exert.



**TWO MILLING CUTTERS ON EACH HEAD** cut opposite slots at the same time. One cutter is 9/16" lower than the other to cut the deeper slots with the same depth of feed. The two heads are driven up and down by 4" cylinders and machine two parts at once. Each head is driven by a 2½/11-gpm combination pump (two pump cartridges with integral hi-lo valving). Deceleration valves slow down the heads before machining. Counterbalance valves provide back pressure for a smooth feed.

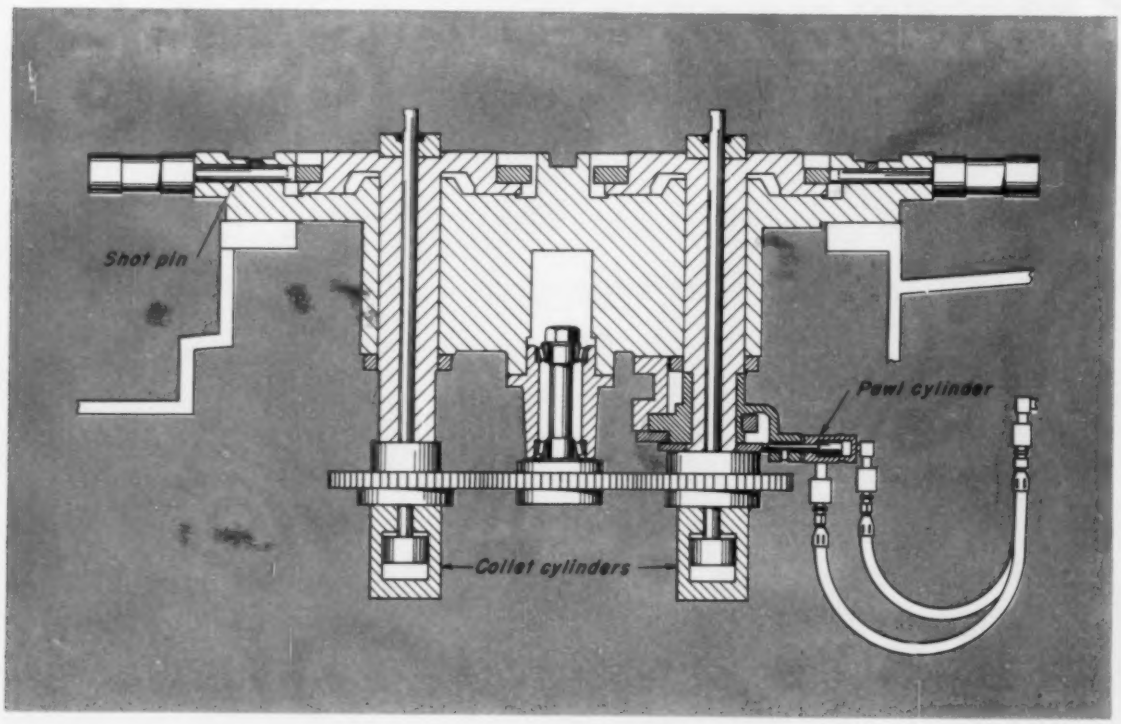


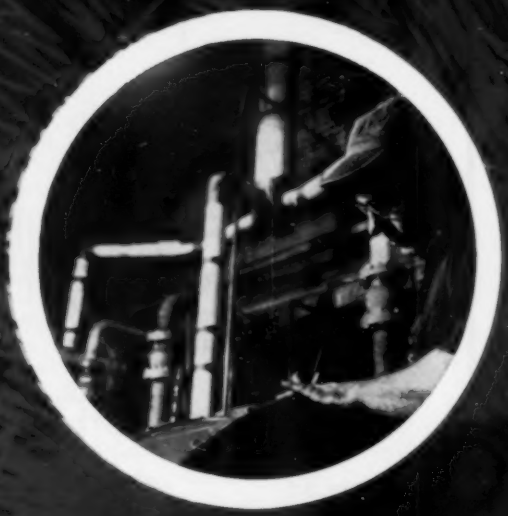



**INDEX TABLES ROTATE** when INDEX cylinder retracts. The tables are geared together through an idler. Shot pins position and hold the tables at each of three positions.

Sequence valves in the lines to the INDEX cylinder allow the PAWL cylinder to engage before indexing and disengage after indexing.

**COLLET CYLINDERS EXTEND** through the centers of the index tables. Each has a 3" bore, 1" stroke. The PAWL cylinder is connected through rubber hose and swivel joints to prevent twisting the hose.

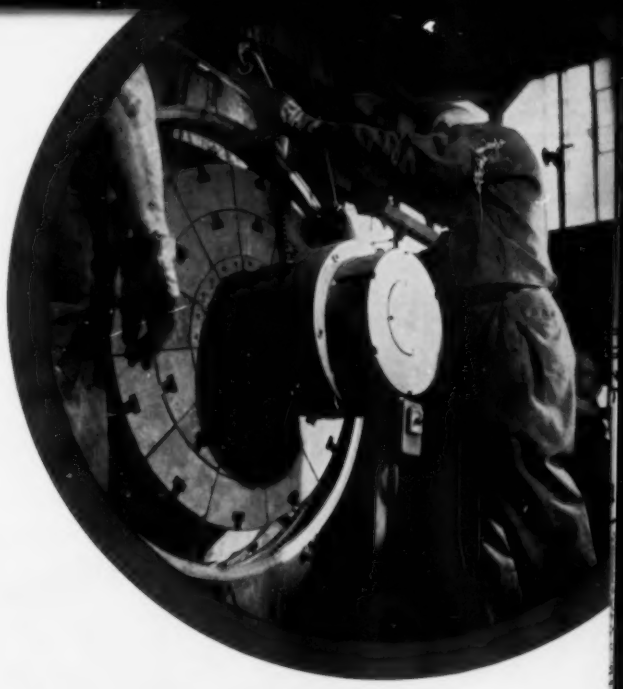




In Amweld's [illegible] compressors are all tied into a common header. To increase compressor efficiency and reduce condensation in cylinders and air lines, Mobil recommended changes in the location of intake openings, reduced flow rate of jacket cooling water, and increased water flow rate in the after-cooler. Result: an increase of 5% in compressor efficiency, and cooler, drier air in plant air lines.

# Amweld rings up $14,621

On 8 ring-sizing machines Amweld was experiencing hydraulic difficulties similar to those in the butt welding units. Oil deposits, sticking valves, pump failures, etc. were common problems. 1040 maintenance man-hours a year were required to keep the equipment operating. But again the introduction of a Mobil hydraulic oil and preventive maintenance procedures slashed this labor cost, saved Amweld $2,005 the first year.



On three of Amweld's expander units, brass wear plates on the expanding mandrel were undergoing serious wear. Frequent replacement of these plates, with attendant labor costs, meant a $3,936 expenditure for Amweld in one year alone. Studying the problem, Mobil Engineers recommended an extreme pressure grease. In the year since this Mobil product was introduced, not a single replacement has been made.

# *savings with Mobil!*

## A leading producer of welded rings, American Welding & Manufacturing Co. cuts maintenance costs with Mobil Lubricants and engineering service.

Specializing in the production of welded rings, bands and assemblies, American Welding has developed methods and techniques for precision-welding alloy steels and non-ferrous materials in both light gauges and heavy sections. Parts are supplied "as-welded," or machined and finished, to prime contractors, and include components for jet engines and missiles.

Critical tolerance requirements demand rigid maintenance procedures at Amweld. And Mobil products and engineering service have made significant contributions in terms of minimized machine downtime and consistent savings in lubricant and parts costs. Working in close cooperation with Amweld technical personnel, Mobil has made recommendations that have saved this producer $14,621.

Mobil's extensive background in lubrication may help you achieve similar savings in your plant. Your Mobil Representative is the man who can tell you.

Mobil

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# Looking at shock

● By **HERB H. SCHMIEL,**
*Chief Engineer, Parker Hydraulics Div., Parker-Hannifin Corp., Cleveland, Ohio.*

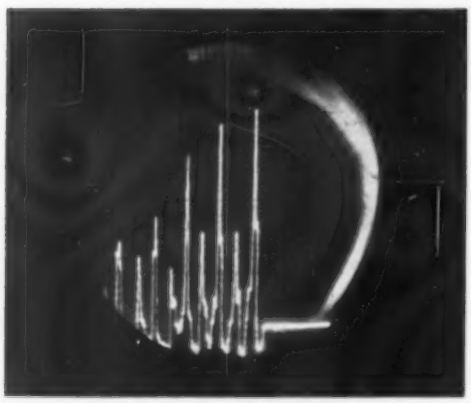
ONE of the most common causes of components failing in the field is surge or shock pressures. For example, the hydraulic lift circuit on a front-end loader may have extreme shock pressures when the truck hits a bump while carrying a load. Production tests of hydraulic components tell whether they meet static operational requirements, but it's often difficult to duplicate the exact operating conditions in mobile equipment.

Sensitive test instruments are needed to check a hydraulic system thoroughly for shock pressure. Pressure gages are not fast enough to show these transients.

**THESE TEST ENGINEERS** are looking at shock as the loader bumps over a log.

Test engineers at Parker Hydraulics Division use an oscilloscope to check system operation. The oscilloscope, designed especially for this use, is an electronic analyzer which registers static and transient pressures on a cathode-ray tube. Its six pressure pickup elements give it a range of 0 to 10,000 psi.

Because it requires no separate amplifier, the oscilloscope is very portable for field work. Parker field engineers use their own generator to power it, so they can conduct tests where no other power is available. It also gives them a consistent supply, so test results can be accurately evaluated. ▼▼▼



**OSCILLOSCOPE TRACE** moving from right to left indicates the peak shock pressure when a front end loader hits a bump while carrying a load. The load bounces, then gradually settles down.

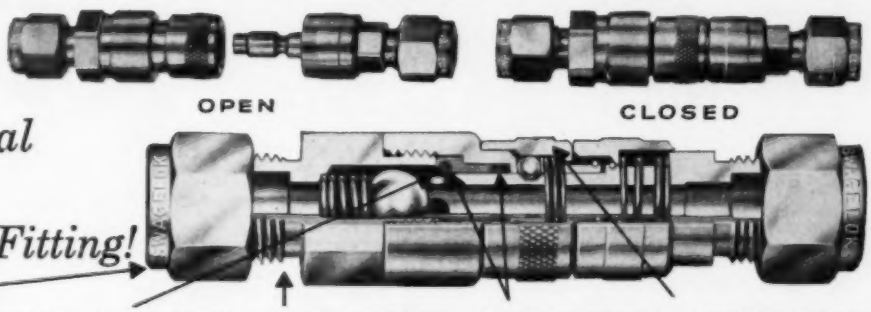


Circle 38 →

# What's the secret of this fast, positive-seal fitting?

Swagelok Quick-Connect Fitting Installation in Boeing Airplane Company, Seattle, Wash., Test Facilities for Boeing 707 Jet Stratoliner.

*Here's the secret of this fast, positive-seal Swagelok Quick-Connect Fitting!*




**1.** Swagelok Quick-Connects with single end or double end shut off for tube to pipe, tube to tube, bulkhead tube to tube applications are available in brass and stainless steel in sizes for ¼" and ⅜" O. D. tubing.

**2.** Flow resumed instantly and vacuum tight seal assured when connection is made.

**3.** Light, compact, streamlined design. Occupies little space. For use with portable equipment, and bulkhead or panel applications.

**4.** Instant-acting seals completely prevent loss of pressure when fitting is disconnected.

**5.** No twisting, turning or wrench action necessary. Easy straight-line finger tip pull or push action for instant connecting or disconnecting.

In the Boeing Airplane Company photo shown above, the tubes are instrumentation pressure lines running from the large jet engines on test stands to the patch board, where the lines are coupled into measuring devices.

The Boeing Airplane Company adopted this positive Swagelok Quick-Connect Fitting to simplify test installations, and substantially cut down test set-up time. Both ends of the many pressure lines are Swagelok-equipped. Previously, engineers used a screw-type fitting which required a wrench and valuable time-consuming operations to tighten and remove.

Swagelok engineers are equipped with experience, ability, and a wide range of tube fittings designed to meet your individual problems. Quick delivery of Swagelok tube fittings from local distributor stocks.

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Rugged beyond all mil specs, these light weight Bourdon-Helix gauges maintain constant accuracy under the most severe environments.

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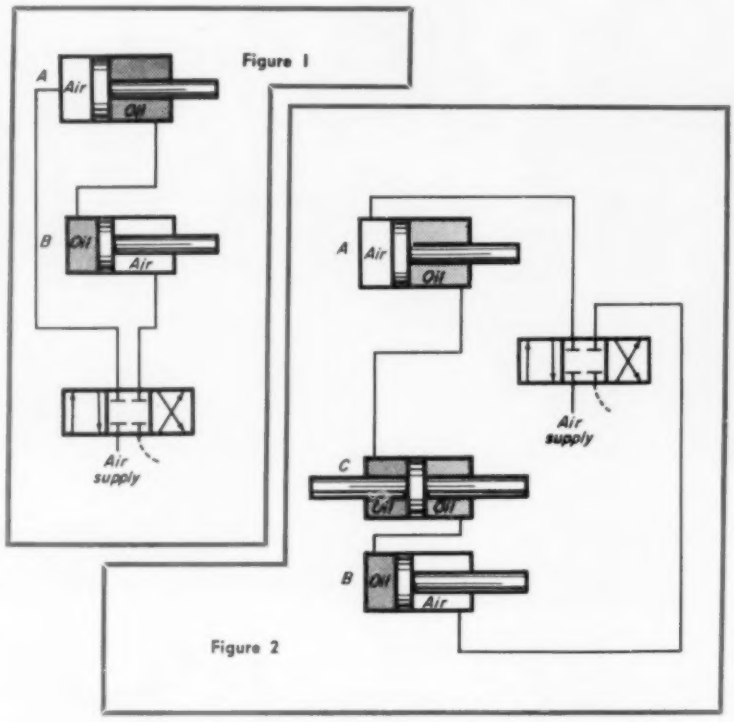
Circle **56** on Time-Saver Card

# Use oil to synchronize air cylinders

• By **JOHN MOLNAR,** *Moorstown, New Jersey*




HYDRAULIC cylinders can be synchronized by metering equal flows to or from them. However, synchronizing *air* cylinders is not quite this simple. Equal quantities of air can be metered to or from cylinders, but the pistons will not move together if load on one is greater than the other.

Here's a way to extend and retract cylinders with air while a confined liquid synchronizes them.

In Figure 1, a control valve applies air to the head end of cylinder *A* or the rod end of cylinder *B*. The rod end of cylinder *A* and the head end of cylinder *B* have the same effective area and are connected and filled with oil. Displacement of these two cylinder ends are equal. When the control valve shifts to extend cylinder *A*, oil displaced from its rod end flows to the head end of cylinder *B*. The cylinders extend together. Total force exerted by both cylinders is equal to air pressure applied times area at the head end of cylinder *A*.

The circuit in Figure 2 uses a double-rod-end cylinder as an intermediate cylinder. Additional cylinders can be added. They must be double-rod-end because displacement of each end must be equal for the cylinders to extend together.

▼▼▼

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for precision hydraulic control valves

4-WAY SELECTOR VALVES IN A VARIETY OF MODELS TO MEET ALL OPERATING REQUIREMENTS

*a complete line for every application*

**GENERAL SPECIFICATIONS**

FLUID: Oil, for hydraulic use only.
PRESSURE: 1500 psi maximum.
FLOW: 3 to 28 gpm.
PORT SIZES: ¼ to 1" pipe size.
MATERIAL: Slides and spools—hardened steel; bodies—gray iron castings.
Various forms of return springs or detents for slide positioning.

**MODELS**

Lever-Operated For Hand Control. Stem-Operated For Remote Manual Control.

Solenoid-Operated in Various DC and AC Voltages.

Pilot-Operated For Remote Hydraulic Control.

*rugged simplicity for efficient, long, reliable service life*

These compact, 4-way selector valves are used for control of double acting, or single acting cylinders. Simple spool-type construction provides a wide variety of porting arrangements for either open-center or closed-center hydraulic systems.

***The Valves With Maximum Operating Efficiency Over The Years***
***Let ADEL be your* single-source *for* precision hydraulic equipment**
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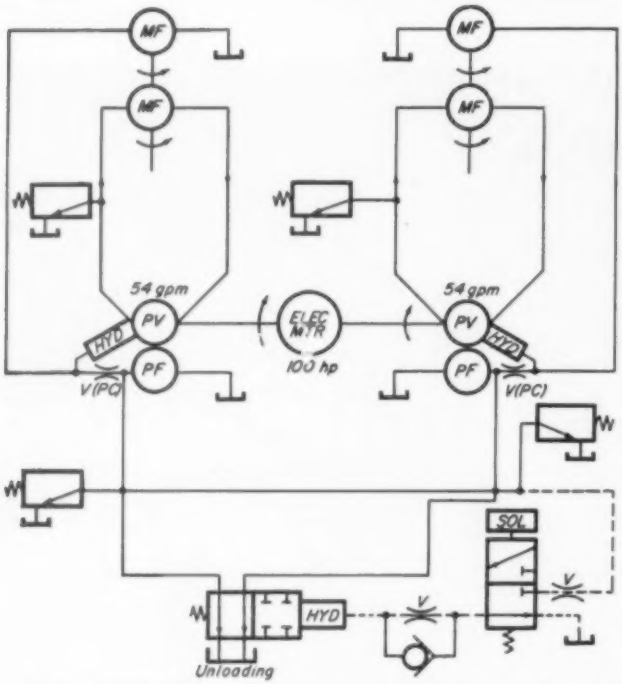



# Controlling speed with pressure

• By **WALTER ERNST**
*Vice President & Director of Engineering*
*Commonwealth Engineering Co., Dayton, Ohio*

ORDINARILY you associate speed with flow, and force with pressure, and keep these two relationships separated in your thinking. But in this system which Commonwealth Engineering and The Oilgear Co. worked out for a road simulator designed for the Navy, pressure and speed are closely related.

The vehicle under test mounts with its front and rear wheels on four rotating drums which have bump plates attached to their surfaces. Contour of these plates simulates road conditions at speeds from 5 to 40 mph. Two, constant displacement, radial piston, fluid motors drive the drums in pairs. Each motor has a torque rating of 4360 in-lb and a maximum speed of 595 rpm. They deliver about 40 hp each.

• **Auxiliary Speed Control Circuit**—Variable flow is delivered to the motors by two radial piston pumps whose displacements are controlled by integral, spring-loaded cylinders. Also integral with the variable volume pumps are small, constant displacement pumps which deliver pressure fluid to control large pump displacement. These auxiliary pumps, which are driven on the same shaft as the main pumps, deliver through pressure-compensated flow control valves to small fluid motors, called tachometer motors, shafted to the main drive motors.

Teed off the inlet lines to these small motors are connections to the displacement controls of the main pumps. Pressure at the inlet of the small motors then positions the main pumps and determines their delivery and resulting drum speeds.

• **Pump Displacement Control**—Each pump's slide block is acted on by a spring-opposed cylinder integral with the pump. The spring drives the block toward neutral. The cylinder is under pressure at the tachometer motor inlet and drives the slide block toward its maximum displacement position. Under stable speed conditions, forces of cylinder and spring balance.

To increase speed, the flow control valve which meters fluid from the auxiliary pump is opened. This directs more of the flow from the auxiliary pump to its tachometer motor and less over the corresponding relief valve. Momentarily this raises pressure in the line to the tachometer motor, because the motor is not rotating fast enough to accept the increased flow.

This increased pressure is applied against the main pump, stroke control and drives the pump to a larger displacement position. The increased pump delivery drives the fluid motors faster until pressure on the main pump control drops to the point where forces on the slide block are again balanced.

• **Acceleration Control**—On starting, if the flow control valves are set for maximum speed, nearly all the flow from the auxiliary pumps would go to the main pump stroking controls and put the pumps on full stroke very fast. This could overload the electric drive motor on starting.

It is preferred to start under no load at all times, so a pilot-operated, 4-way unloading valve was connected to both fixed displacement pumps. The spring-loaded valve unloads the pumps in its deactuated position. It closes when pilot pressure is applied through a solenoid-operated, 3-way valve. This solenoid valve is interlocked with the electric motor which drives the main pumps. Pump shifting speed is controlled by a flow control valve which meters flow to the unloading, 4-way valve.

In an emergency stop, if the auxiliary oil supply were dumped to tank, the main pumps would shift to neutral very rapidly and create a high pressure transient. The relief valves cannot act fast enough to relieve this surge. To prevent this pressure surge and to provide dynamic braking, on normal stops the electric motor is first de-energized, and the solenoid valve then de-energized after a timed period. The motors and pumps then coast to a stop. On emergency stops, the solenoid valve is de-energized immediately, but a flow control valve which controls shifting speed limits deceleration and high pressure surges. ▼▼▼



Circle 154 →

ACTUAL SIZE

# NEW

## WATTS No. 608

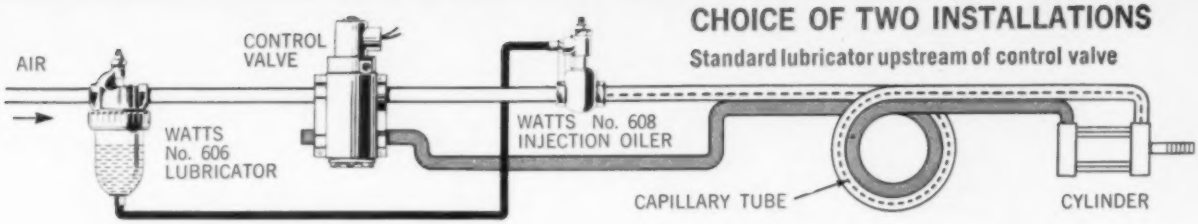
1/4"-3/8"

## AIR CYLINDER INJECTION OILER

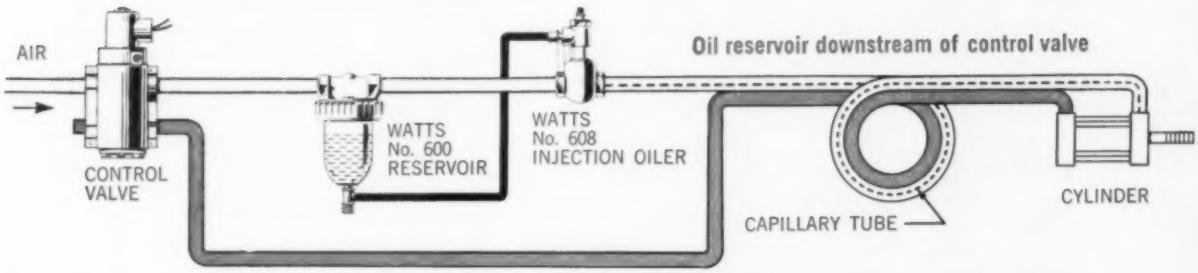
Solves the problem of lubricating low volume, short stroke cylinders

### CHOICE OF TWO INSTALLATIONS

**Standard lubricator upstream of control valve**




**Oil reservoir downstream of control valve**




Most low volume, short stroke air cylinders are impossible to lubricate properly by ordinary mist-type lubrication because of their low air consumption.

The solution is *controlled* oiling—*direct to the cylinder*. It's the *only* way to assure positive lubrication for long cylinder life.

Installed in the pressure line between control valve and air cylinder, Watts' new No. 608 Injection Oiler is designed specifically to deliver metered oil direct to the cylinder through a capillary tube located within the cylinder air supply line.

Find out about the Watts Injection Oiler. Available in kit form (K608), includes No. 608 oiler, 2 ft. oil supply hose and 16 ft. capillary tubing.

Write *Watts Regulator Company, Industrial Division, Lawrence, Massachusetts.*

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YOUR SAFE SPECIFICATION

# WATTS

# What can impulse

• By **ALBERT V. SADA,** *Research and Development*
*The Weatherhead Company, Cleveland, Ohio*

- ► Perform dynamic tests for any hydraulic component
- ► Duplicate all factors which can affect component life
- ► Apply vibration, thermal shock, flow, flexure, and transient pressures
- ► Control these factors during test in same sequence they occur in actual service

*This article was awarded Honorable Mention in the* APPLIED HYDRAULICS & PNEUMATICS *Prize Paper Contest.*

SUDDEN opening or closing of a valve, the bottoming of a piston or a change in pressure cause momentary pressure surges. These surges are transient pressure peaks—often much higher than pump operating pressure. For satisfactory performance, every component in a hydraulic circuit must be able to withstand these transient conditions.

Impulse test machines are used to duplicate system characteristics. They may be built to check every possible factor that causes fatigue failures in a hydraulic system. To the component or systems builder the impulse test machine is a design tool. To the user of hydraulic systems the impulse test machine gives information to establish realistic replacement schedules that will prevent dangerous and costly failures.

• **Know your transients**—Many users of hydraulic equipment don't know the amplitude of the transients in their system. Replacement components in these cases are usually ordered to original specifications. Result: continued failures. Figures 1 and 2 show evidence of this situation. They are oscilloscope trace photographs taken on service engineering calls to determine the cause of system failure.

The machine checked in Figure 2 shows pressures of 200 to 2400 psi with peaks up to 3700 psi. Specs originally setup called for operating pressures of 1600 to 1800 psi. Users of the circuit analyzed in Figure 3 knew that operating pressures ranged from 475 to 750 psi. Peaks of 900 to 1000 psi were expected. The oscilloscope trace shows actual surge peaks of 1200 to 1750 psi.

This information demonstrates the importance of impulse testing to insure proper performance at operating conditions.

• **Using a transfer circuit**—A transfer system separates the hydraulic circuit on the impulse control unit from the component under test. This means that the impulse machine can operate with turbine grade hydraulic oil, while the test part can be checked with the fluid it will use during actual service. This transfer system eliminates costly, time consuming system changes when special fluids are specified as test media. It also allows using only a small amount of the special, more costly fluid.

Transient pressure surges are produced by oil in the peak tubes. Size and length of these tubes are factors in peak and pressure rise. Peak pressure is the force developed by the moving column of oil.

• **Design of transfer cylinder**—A standard 1½-gallon, piston type accumulator was reworked to perform as the fluid transfer device. Figure 4 shows the modifications:

END SEAL added so that sealing action occurs beyond the threads. This eliminates hoop stresses on the threaded portion.

INCREASED CLEARANCE by reducing diameter on piston.

CENTER GROOVE added to piston is filled with 8 to 10 Teflon, backup rings. O-ring grooves widened to take at least 5 backup rings. Rings act as bearings to eliminate piston and cylinder contact.

Before rework, failure occurred after about 100,000 cycles. This was tube scoring or failure at the thread. Service with reworked cylinders exceeds 8 million cycles without failure. O-rings are replaced every 200,000 cycles or when special fluids require different packing material.

These impulse machines cost $10,000 to $25,000 depending on capacity and the test conditions which are controlled and measured. ▼▼▼

# machines do?

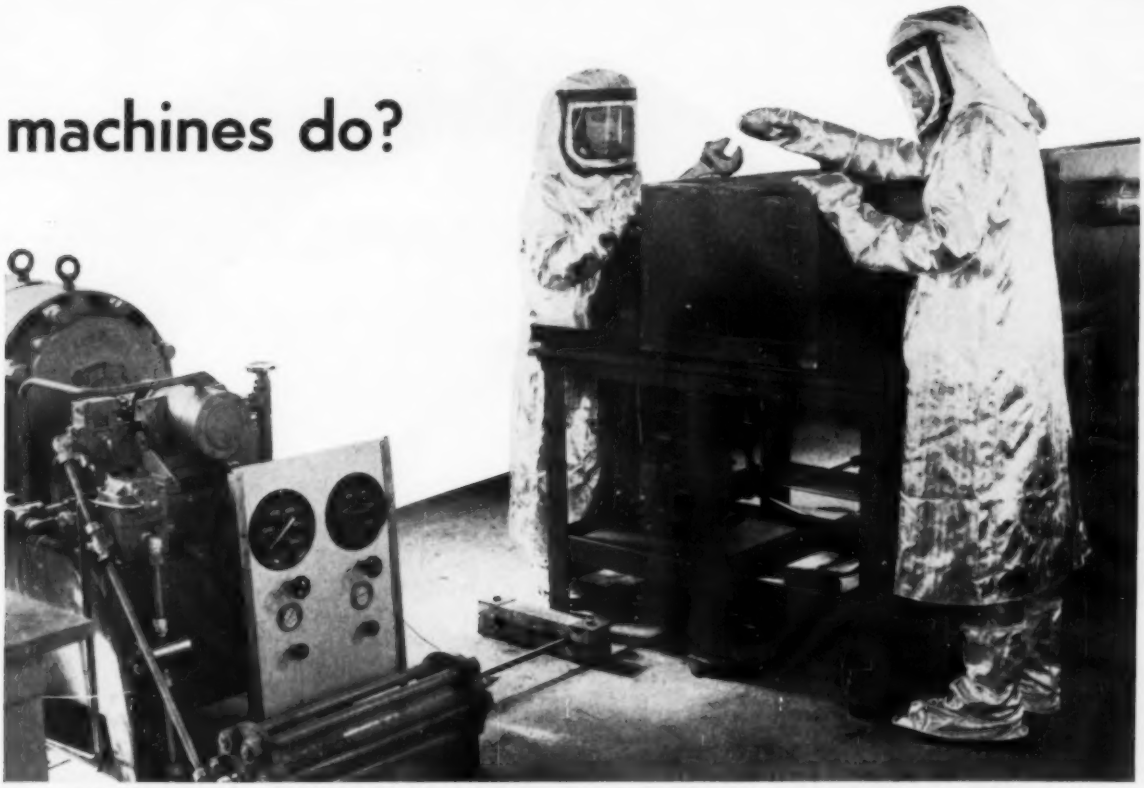

**FIG. 1. PRESSURE PEAKS** of 7500 psi at 180,000 psi/second pressure rise are produced on this impulse equipment. Temperature in the test cell can be varied from —75 F to 800 F. Vibrations up to 1750 cpm can be applied.

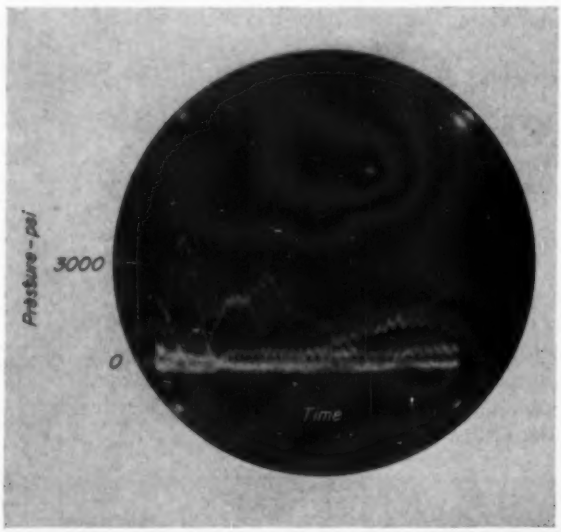


**FIG. 2. PRESSURE PEAKS** go to 3700 psi on equipment designed for 1800 psi.

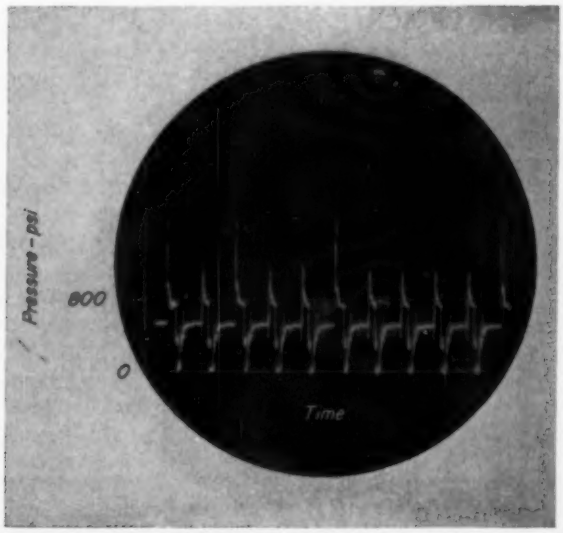


**FIG. 3. EXPECTED PEAKS OF 1000 PSI** are actually 1200 to 1750 psi.

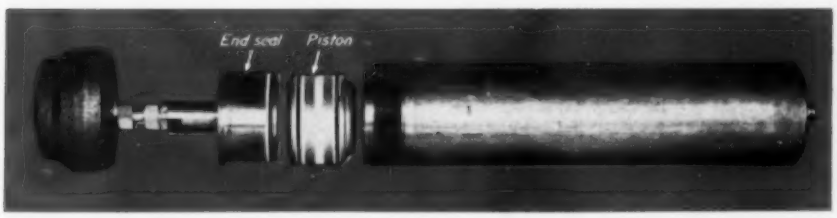


**FIG. 4. MODIFIED PISTON ACCUMULATOR** has end seal added, increased piston clearance, and teflon back-up rings for piston bearings.

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Specially designed for double-acting cylinders—the new "Hallprene" Patent Double-Acting Fluid Seal.

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- ✳ Simplifies piston design
- ✳ One seal replaces two

The new "Hallprene" double-acting seal has been developed from the highly successful "Hallprene" Patent Fluid Seal—the most efficient seal for single-acting applications.

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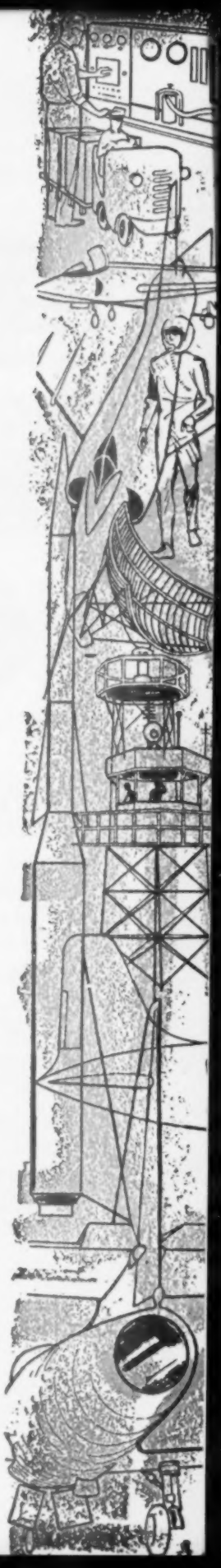
*Fluid Systems For Flight and Ground Support*



### *Bendix Developing Minuteman Hoist*

A hydraulic hoist powerful enough to emplace an Air Force Minuteman is under development by engineers of The Bendix Corp., North Hollywood, Calif. The hoist can handle loads up to 100,000 lb, though it weighs only 2000 lb. Simulated emplacement of the three-stage Minuteman ICBM will use a test silo similar to the actual underground launcher, a dummy missile and its container, and a tractor-trailer transporter. Two remotely-controlled, telescoping cylinders—each 35 ft long extended—will lower the missile into the test hole, 62 ft deep and 9 ft in diameter. The cylinders will raise the missile and its aluminum container from their resting place aboard the transporter, suspend them vertically over the hole, and then lower the missile into position.

### *R & D Contract For High Temperature, Fire-Resistant Fluids*

A contract to develop fire-resistant fluids for use in high speed, aerospace vehicles, where temperatures are too high for conventional fluids, has been awarded to E. F. Houghton & Co., Philadelphia, by the USAF. The R & D contract is under the direction of the Nonmetallic Materials Laboratory, WADD. It is an extension of the AF program to provide materials for efficient performance of new space vehicles.

### *Missile Valve Production Announced By The Special Corp.*

The 50-year old Special Corp., Brooklyn, is expanding its line of valves and regulators through its new affiliate, Flodyne Controls, Inc. Flodyne Controls specializes in valves and regulators for the missile, rocket, and atomic energy fields for corrosive, cryogenic, and high-pressure applications to meet airborne and ground support specifications.

### *All Convair Jet Liners To Use Vickers Pumps*

Yoke type, variable displacement pumps manufactured by the Aero Hydraulics Div. of Vickers Incorporated are slated for use on all Convair jet liners, including models 880, 880M, and 990. They had been selected earlier for the Convair 990. The 880 and 880M models already completed are to be refitted with Vickers units. Each airplane has two hydraulic systems with two pumps in each system.

For more news about fluid systems see page 120

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# Understanding contamination

• By **H. D. DAVIS**, *Group Engineer, Hydraulic Design, Convair (Astronautics) Div., General Dynamics Corp., San Diego, Calif.*

*Servo system demands on aerospace hydraulic systems has made fluid contamination a severe problem. Recently there have been increased efforts to measure it, control it, and determine its effect on systems performance. Like early medical investigations in bacteriology where the enemy was also invisible and unknown, the fight has been slow and often painful.*

*Photomicrographs courtesy of Bendix Filter Division, The Bendix Corporation*

FORMER aircraft hydraulic systems had contamination problems similar to present industrial hydraulic systems. Contamination caused undue pump and valve wear and occasional jamming of manually or remotely-controlled devices. Aircraft filters were similar to present industrial hydraulic filters: coarse wire screens, self-cleaning edge types, compressed paper, or sintered metal elements.

Contamination problems increased when fluid power was applied to flight control systems, first for power assist on booster systems and later in pure servo systems.

Filtration art was inadequate for these systems. Most filters were too coarse. The best ones had elements of resin-impregnated. compressed paper or sintered metal. Each had faults. Paper elements shed fibers, had poor end cap retention, and collapsed under relatively low differential pressure. Sintered metal elements also shed, had inconsistent porosity, and were fragile under vibration or rough handling.

The methods of filter evaluation were limited. Originally, a standard, test dust was used to establish particle size and dirt-holding capacity. This was done by microscopic examination of effluent samples centrifuged from test filters. The method was somewhat haphazard because effluent samples did not collect all the contaminant added. This brought up the question: was the sample representative? Also, extraneous, airborne contaminant could not be distinguished from test contaminant.

• **Servovalve and Filter Developments**—Several recent, important advances in understanding and controlling contamination are:

**The two-stage electrohydraulic servovalve which minimizes silting effects by amplifying input power several hundred times.**

**Closely woven, stainless steel, wire mesh filter.**

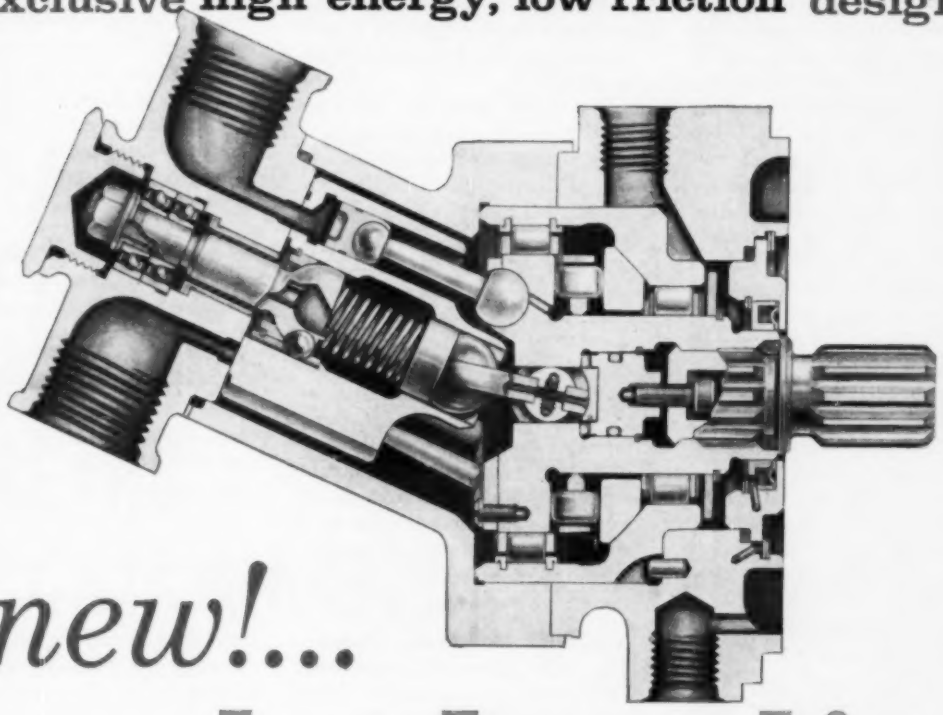
**Cellular, plastic membrane filter.**

**Glass beads for filter evaluation.**

**Bubble point test.**

• **Two-Stage Servovalve**—The most important step forward in the battle against contamination was the development of the two-stage, electrohydraulic servovalve

## exclusive high energy, low friction design



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*with basically new design features offering basically better performance!*

Free — Product Data Bulletin No. 25 describes Cornelius Aero Hydraulics equipment; includes installation information, specifications and performance data. Write today.

Here is important news for hydraulic design engineers. The Cornelius Company is pleased to announce development of a new line of hydraulic motors and pumps that are lighter, more efficient and more compact. The exclusive, new **high energy, low friction** design of this equipment is possible because of Cornelius inventions. Nine U.S. and foreign patents covering these products have been issued to date.

If you have unsolved problems in hydraulic motors and pumps or are not entirely satisfied with the performance you are now getting from your present equipment, be sure to investigate these new Cornelius products. These new Cornelius pumps and motors can be tailored to meet your system requirements.

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where the first stage amplifies force to move the main spool.

In early, single stage servovalves, electrical signals from the flight control system energized an electromagnetic circuit which operated the valve by direct mechanical linkage. Electrical power to the valve was very low. To reduce leakage, lap fits of spools to sleeves were relatively tight—usually 0.0002 in. or 5 microns. Low power and tight fit meant that a small amount of fine contaminant lodging in the valve caused it to silt up and fail.

Using a mechanical feedback linkage to close the servo loop and system power to keep the spool moving gave temporary relief from silting. But this was unsatisfactory because it required bulky, heavy linkages which had backlash, and were difficult to calibrate.

In two-stage valves, with several hundred times more power available to move the main spool than in single-stage valves, the effect of silting is reduced.

• **Wire Mesh Filter**—The second great stride was the closely woven, stainless steel, wire mesh filter developed in Germany about 1946. Though not a panacea, it represented an immediate improvement over other filters. The filtering medium is closely woven wire cloth. Dutch twill weave produces stronger, more dense cloth. Maximum pore size for as manufactured, uncalendered cloth is 23 to 25 microns.

The main advantage of wire mesh is regular, controllable pore size. Also, it can be made into a rugged element which resists vibration and rough handling. When properly supported within in-line elements, wire mesh withstands 4500-psi differential pressure without collapse. The high structural strength of the element is especially important when the filter element relief valve is eliminated to prevent dumping filtered contaminant into the system. Because of its basic ruggedness, it is highly resistant to migration or shedding of the filter medium into the fluid stream. Properly made, it resists media migration under the worst missile environmental conditions.

• **Plastic Membrane Filter**—The third advance against contamination was application of cellular plastic membrane filters to aircraft hydraulics. This filter also originated in Germany and was first used in the U. S. in medical research to replace ordinary, compressed paper, laboratory filters. Plastic membrane is used mostly in hydraulic laboratory applications.

Because it is essentially a flat, plastic wafer with closely controlled, nearly circular openings, contaminants trapped by the filter are deposited on its surface instead of being ensnared in a mat of fibers. The contaminants can then be studied microscopically against a background that appears uniform. Surface retention also reveals fibrous contaminants that would be overlooked with a compressed paper filter.

Pore size can be very small and is regular in size and distribution. The common rating in the aircraft industry is 0.45-0.02 microns. This size easily passes hydraulic fluid under vacuum filtration and is much smaller than most contaminants. With vacuum filtration, a vacuum is applied to the downstream side of the filter to suck the fluid through. This laboratory filter is an invaluable tool for evaluating operational filters and determining the contamination level of components and systems.

• **Glass Bead Testing**—Glass beads for filter evaluation and the resulting bubble test that was developed, were important steps in understanding contamination. When using test dust to determine porosity, or degree of filtration, of a filter element, it was impossible to distinguish it from random contaminants from the laboratory. Another failing was that test dust particles were not uniform in shape and size distribution.

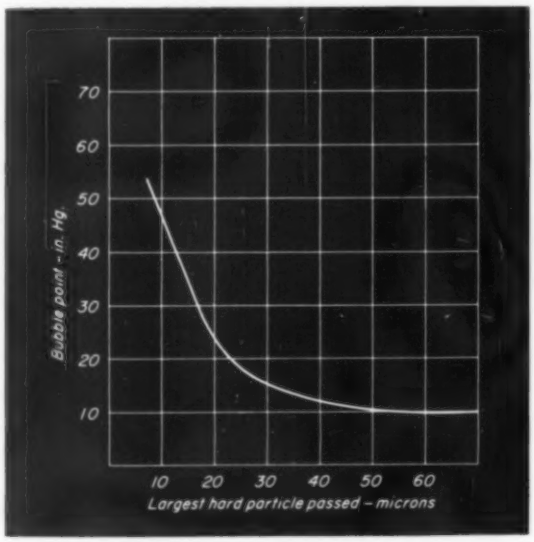
Glass beads are nearly ideal artificial contaminants. The beads are almost spherical and appear highly polished, and easy to discriminate under a microscope. Size distribution is determined by sampling and falls within the range for filter evaluation.

Glass beads make it possible to judge filters both microscopically and on a contaminant weight basis.

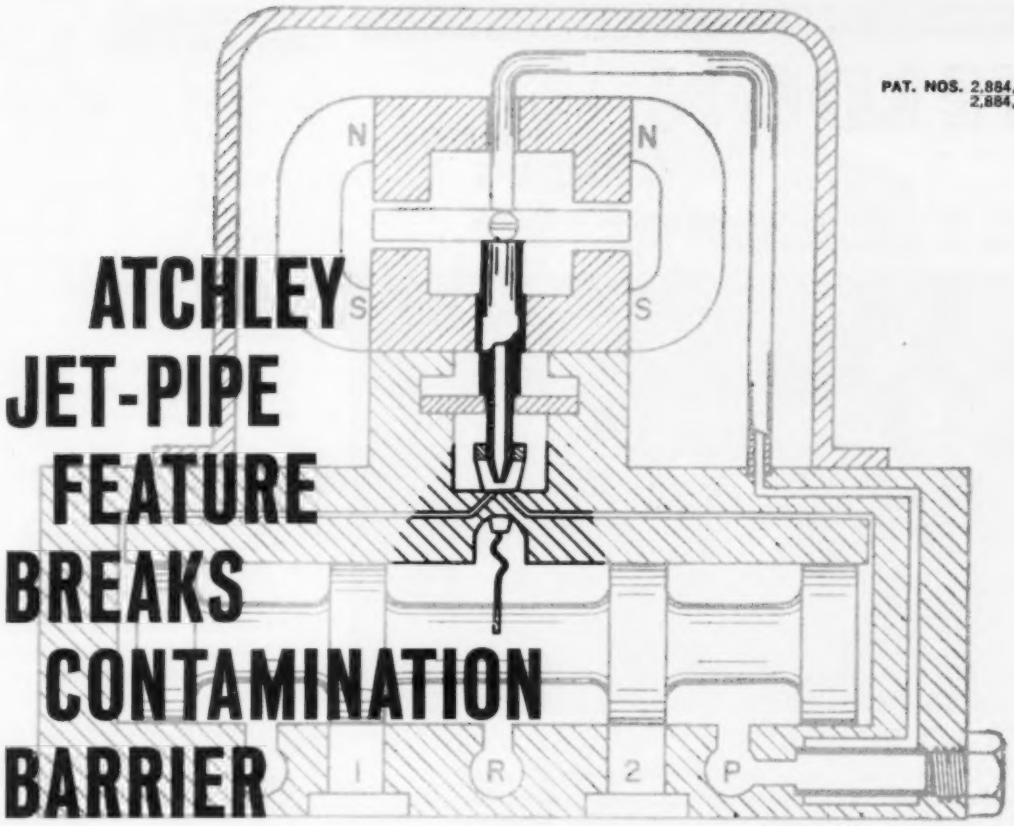
When the biggest, hard, spherical particle that a given filter element could pass was determined, pore size could also be determined by an easily reproducible and even more artificial means—the bubble point test.

• **Bubble Point Testing**—A filter element is immersed in a fluid

Continued on page 110




**BUBBLE POINT TEST** indicates the air pressure at which a bubble first breaks loose from the filter. This pressure corresponds with the largets hard particle passed. This curve correlates the largest filter pore size for sintered stainless steel wire mesh immersed in denatured alcohol, and the bubble point pressure.

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# ATCHLEY JET-PIPE FEATURE BREAKS CONTAMINATION BARRIER

## *Unique Servovalve Design Provides Answer to Fluid, Gas Contamination Problems*

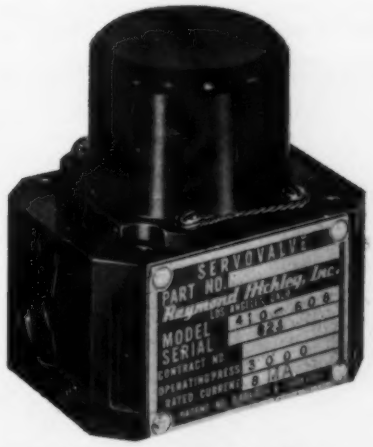
The *Jet Pipe* Servovalve developed by Raymond Atchley, Inc., has broken through technological barriers to achieve a new high in automatic control system reliability by virtually eliminating contamination as a factor in reliability and performance.

In five separate and independent tests at unprecedented levels of contamination—25 times greater than previously feasible—the Atchley *Jet Pipe* Servovalve demonstrated ability to perform continuously with complete reliability.

This greater capability assures positive automatic control in all airborne or ground electrohydraulic systems without painstaking and costly contamination control measures.

Key to this new peak of performance is unique *Jet Pipe* construction permitting passage of particles as large as 200 microns through both first and second stages without malfunction. Single oil source in first stage eliminates possibility of hard-over signals due to contamination. Second stage is precision-controlled by push-pull, frictionless, force feedback servo.

Results of the rigorous tests affirmed that the Atchley *Jet Pipe* Servovalve effectively removes the contamination as a factor in reliability. It's another achievement confirming Atchley leadership in the field. For complete information, write for bulletin on Atchley's *Jet Pipe* Servovalve.

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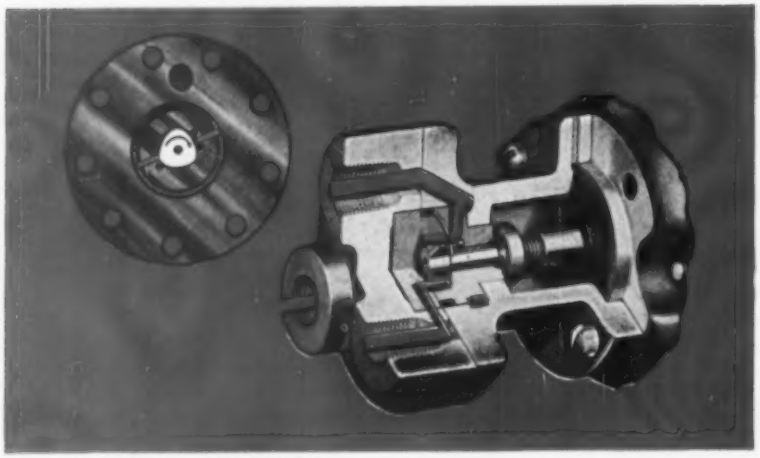
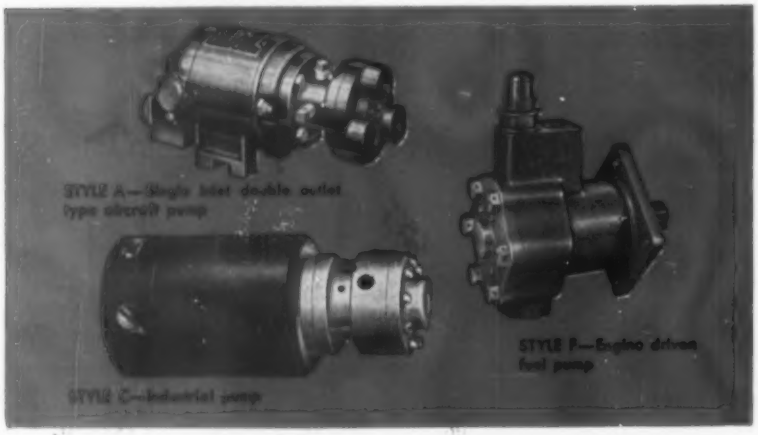


## IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.

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## UNDERSTANDING CONTAMINATION

such as hydraulic oil or denatured alcohol. Gradually increasing air pressure is applied to the inside of the element while it is rotated in a horizontal plane ½ in. below the fluid's surface. A bubble first breaks loose from the largest opening in the element within a 7% linear deviation in air pressure. There is a definite relationship between the air pressure required to create the bubble on a specific filter medium in a specific fluid and the microscopic data from glass bead tests. Thus it is possible to determine the maximum pore size for that medium and fluid from the first-bubble air pressure.

The bubble point and glass bead tests do not give completely true evaluations of filter media because they do not take into account the value of depth filtration in removing fibrous contaminants. They are, however, simplified and reproducible methods of filter evaluation. The bubble point test is especially valuable because it is a nondestructive check on filter quality. It can be conducted on any element, new or used, in a matter of minutes, once the curve of bubble point vs. particle size is known for that filter medium and fluid. To obtain similar data, using glass beads or standardized test dust, requires elaborate test equipment, controlled laboratory environment, and hours of work.

• **In the Future**—We see from review of contamination history that many important steps have been taken to improve our capacity to live with contamination and to improve our techniques for contamination measurement. Through the continued interest of airframe and filter manufacturers, the military services, and the technical societies, the attack on contamination moves forward.

We can look forward to improved servovalves and filters; general contamination control in components, fluids, and systems; standardized contamination measurement procedures; and electronic contamination counters. In another five years, contamination will be well under control. ▼▼▼

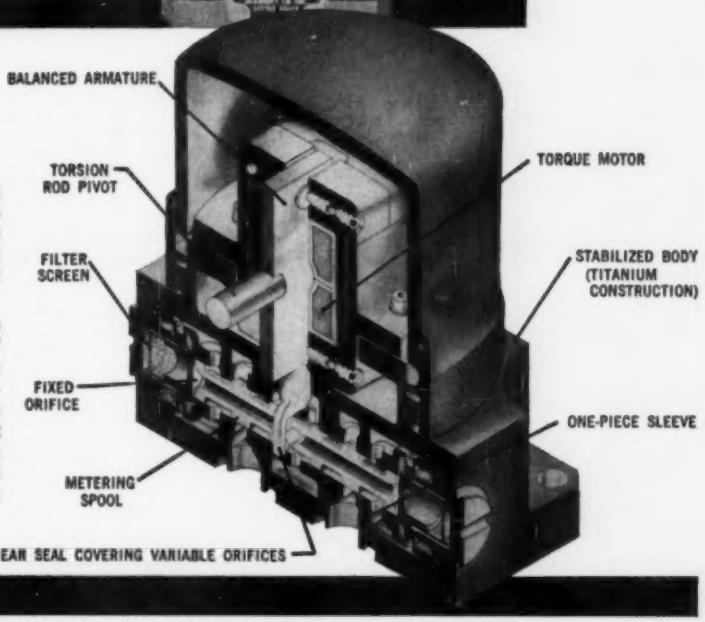
**NOW IN PRODUCTION**

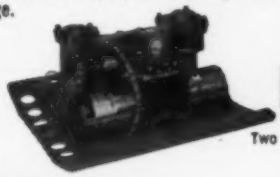
# A FEEDBACK SERVO VALVE WITHOUT SPRINGS OR LEVERS

- *Unity coupled Hydromechanical Feedback*
- *High Null Accuracy*
- *Only 2 moving parts*
- *Large, full opening, shear-seal orifices*

This two-stage, four-way flow control valve is the only one available that provides true positional feedback without springs or levers. The first stage consists of an electrical torque motor and "shear-seal" orifice hydraulic amplifier, while the second or control stage is made up of an accurately matched spool and sleeve arrangement.

Hydromechanical unity feedback relates spool position to torque motor armature position and also nulls out effects of orifice variations due to supply pressure and temperature fluctuations. Flow force reactions are thus substantially reduced and hydraulic centering of pilot position is feasible without spring hysteresis and null shift. Large orifices prevent clogging and silting and high shear forces permit efficient operation even with highly contaminated fluids. Final null adjustments are made electrically by a balancing control at amplifier output stage.



Integrated Control Module Includes Kearfott's Electrohydraulic Servo Valve, Two Rotary Output Shafts, Geared Pump and Pressurized Sump.

**TYPICAL CHARACTERISTICS**

| | Medium Flow (#6103-#6106) | High Flow (#6104) |
|---|---|---|
| **Rated flow** | to 7.5 gpm at 3000 psi valve pressure drop | to 18.0 gpm at 3000 psi valve pressure drop |
| **Hysteresis** | 3% maximum total rated current | 3% maximum total rated current |
| **Supply pressure** | 300 to 3000 psi | 300 to 4000 psi |
| **Proof pressure** | 4500 psi pressure port 3000 psi return port | 6000 psi pressure port 3000 psi return port |
| **Pressure gain** | First stage—500 psi per ma minimum with 3000 psi supply | First stage—500 psi per ma minimum with 3000 psi supply |
| **Load pressure gain** | 8500 psi per ma minimum with 3000 psi supply | 10,000 psi per ma minimum with 3000 psi supply |
| **Temperature** | −65°F to +275°F | −65°F to +275°F |

| | Medium Flow (#6103-#6106) (% of rated current) | High Flow (#6104) |
|---|---|---|
| **Maximum Null Shift Temperature Change per 100°F** | 1% | 1% |
| **Supply Pressure Variation ±** | 2% | 2% |
| **Quiescent Current Change 20%** | 1% | 1% |
| **Weight** | 12 ounces | 16 ounces |

**TORQUE MOTOR:** Note: 6103 & 6106 identical with exception of torque motor characteristics.

| | Valve #6103 | Valve #6106 |
|---|---|---|
| **Input Power** | 300 Milliwatts | 64 Milliwatts |
| **Rated Current** | ± 10 ma | ± 8 ma |
| **DC Coil Resistance (other motors also available)** | 3000 ohms/coil | 1000 ohms/coil |

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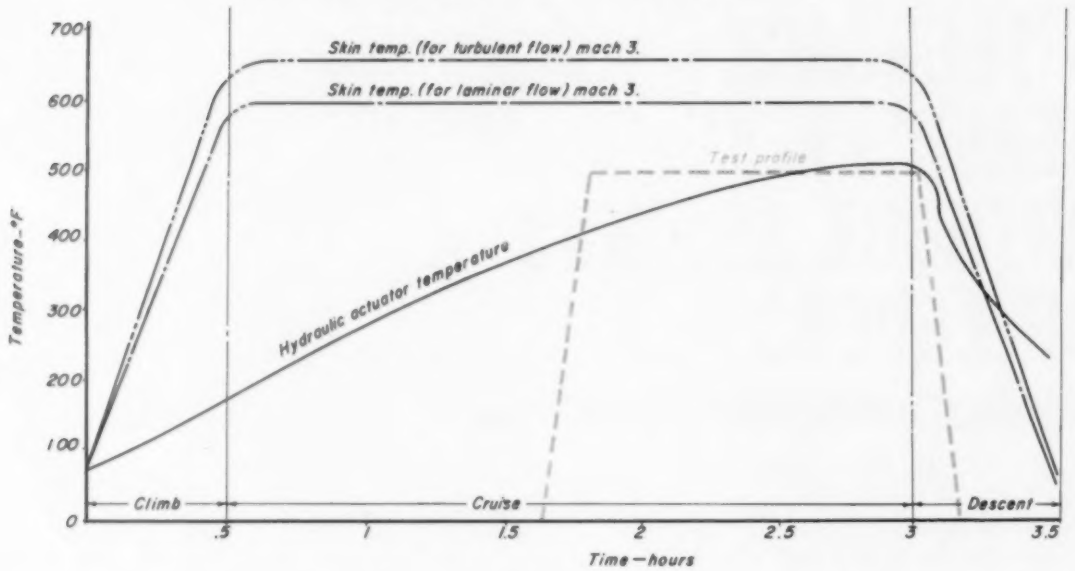
TEST PROFILE SIMULATES ACTUAL TEMPERATURE CHANGE.




# Mission profile testing

• By **DONALD L. TAYLOR,** *Research Engineer, Lockheed Aircraft Corp., California Div., Burbank, Calif.*

AIRBORNE components are usually tested by cycling at various frequencies, temperatures, and pressures. The results of these tests are usually in terms of the number of cycles the component endured before failure. This information is difficult—if not impossible—to relate to the part's life expectancy under actual flight conditions. At best, these results only compare the performance of components subjected to the same test.

As space craft extend their ranges and velocities, additional complex factors must be considered. Problems like thermal shock and duration of optimum temperatures become such important factors that the conventional, arbitrarily selective type of cycling yields results of no practical value to the designer.

• **Mission Profile Testing**—This new method of testing small airborne components overcomes many of the shortcomings of conventional cycle testing. It can be used for environmental testing of all types of airborne components. A battery of heaters can simulate localized temperatures at critical points such as reciprocating rod seals, or an oven can test an entire unit. This type of performance testing has been carried on at the Research Laboratories of the Lockheed Aircraft Corp. for the past two years.

Each mission profile is related to the component's performance. To illustrate, consider an actuating cylinder in the hydraulic system of a Mach 3 transport aircraft. The plane's operational range is 6000 miles. To plan a realistic mission profile, consider two factors that affect actuator performance: temperature-time relationship, and actuator movement.

• **Temperature-Time Pattern**—The curves of wall temperature vs Mach number are for operation in the stratosphere of arctic regions neglecting solar radiation. A reasonable approximation of stabilized skin temperature due to kinetic heating at Mach 3 is 655 F assuming turbulent flow, and 590 F assuming laminar flow. Method of take-off, rate of climb, and other factors will influence the time required to reach the stabilized skin temperature. In this example, 30 minutes is reasonable.

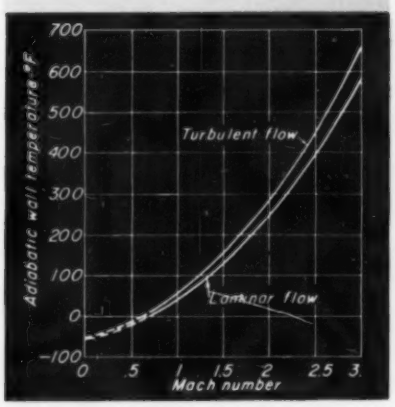
With an operational range of 6000 miles, total flight time (take-off to landing) is approximately 3.5 hours. Temperature-time curves can be plotted for the aircraft skin for both turbulent and laminar flow.

However, the temperature-time curve for the hydraulic actuator will have a different thermal pattern because the aircraft structure, fuel quantity and method of storage, volume-space relationship, and mass of internal equipment provide a heat sink. The actuator may be cooled. All these factors must be approximated to plot the actuator temperature-time curve.

The critical performance factor

## ADVANTAGES OF MISSILE PROFILE TESTING

1. **Results have a practical value. They are functional and useable.**
2. **Test patterns are closely related to the unit's actual operating conditions. Each unit has its own thermal profile.**
3. **Thermal profile is easy to produce. With a variable control, a test apparatus could produce as many different profiles as desired.**
4. **The test simulates the mission at a faster rate.**




**SKIN TEMPERATURE** produced by friction.

is not the rate of temperature rise or the decay, but rather the *length of time actually spent at maximum temperature*. Thus, laboratory test time can be reduced by heating as fast as the test equipment permits.

The final test profile simulates the temperature-time characteristics of the actuator during one flight or mission.

● **Actuator Movement**—Cycling patterns and operating pressures depend on the actuator installation. Cycling may be constant amplitudes and frequencies related to flight conditions. A more realistic method is to use a random actuator travel. The best method is to tape record the motion of a similar actuator under actual flight conditions, and use this tape to control the actuator during the tests. ▼▼▼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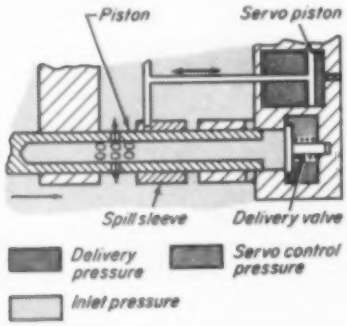
# British Aircraft Hydraulics: Farnborough Show 1960

• By JOHN A. LANKESTER, *European Editor*

MAJOR suppliers of hydraulic equipment for aircraft were represented at the 21st annual flying display and exhibition staged at Farnborough in September by the British Society of Aircraft Constructors. Probably the greatest advances noticeable this year were in the field of hydraulic servo equipment, and a great variety of servo systems and valves was displayed.

• **Pump Has Servo Piston**—A new type of servo-controlled pump has been introduced by Integral Ltd. Output is infinitely variable up to maximum at any desired




**PUMP DISPLACEMENT MECHANISM** is shown at no flow with its spill sleeve retracted, uncovering the spill holes. With this method of control there is no load on the servo piston mechanism which is, therefore, rateless. This gives the pump accuracy of control and stability.

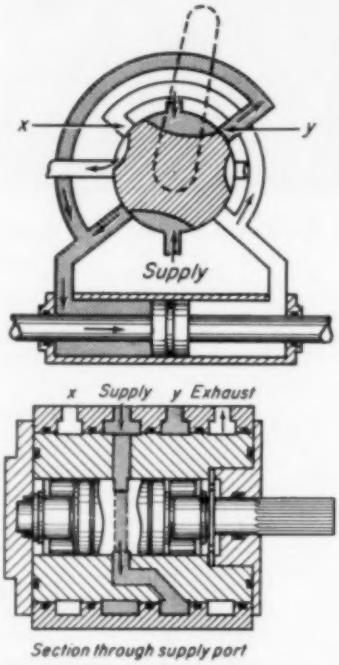
preset, constant pressure and at a given speed. It can also be set to give a constant delivery at the preset pressure while the speed varies over a wide range. This series covers deliveries from 1 to 30 gpm, pressures to 5000 psi constant pressure setting, and operating speeds from 3000 to 8000 rpm.

Swashplate design is used. Delivery is varied by a servo piston linked to spill sleeves surrounding the pump pistons. Each piston is hollow with spill holes drilled radially from outside to inside. At reduced flow or no flow the servo piston moves the sleeves and uncovers the spill holes. This releases fluid from the pistons back into the pump casing instead of out through the delivery valves into the system. This gives almost full delivery right up to cut-off pressure.

Vickers Incorporated, Aero Hydraulics Division, whose products are made in Britain under license by The Sperry Gyroscope Co., Ltd., showed the new Vickers servovalve weighing only 8.5 oz. This unit handles from 0.25 to 7 gpm at 3000 psi. It can be packaged with Vickers standard or miniaturized, piston type, hydraulic motors for an exceptionally compact assembly.

• **Fixed Angle, Variable Pump**—Another new Vickers product at the Sperry booth was the fixed angle, variable delivery, axial piston pump. The output is varied by a movable valve plate which changes position of the inlet and discharge ports. In the maximum delivery position, the plate allows oil to enter and leave the cylinders throughout the full piston stroke. Moving the plate through 90° rearranges the ports so that they are open equally to both intake and delivery strokes resulting in zero delivery. Intermediate settings vary discharge volume accordingly.

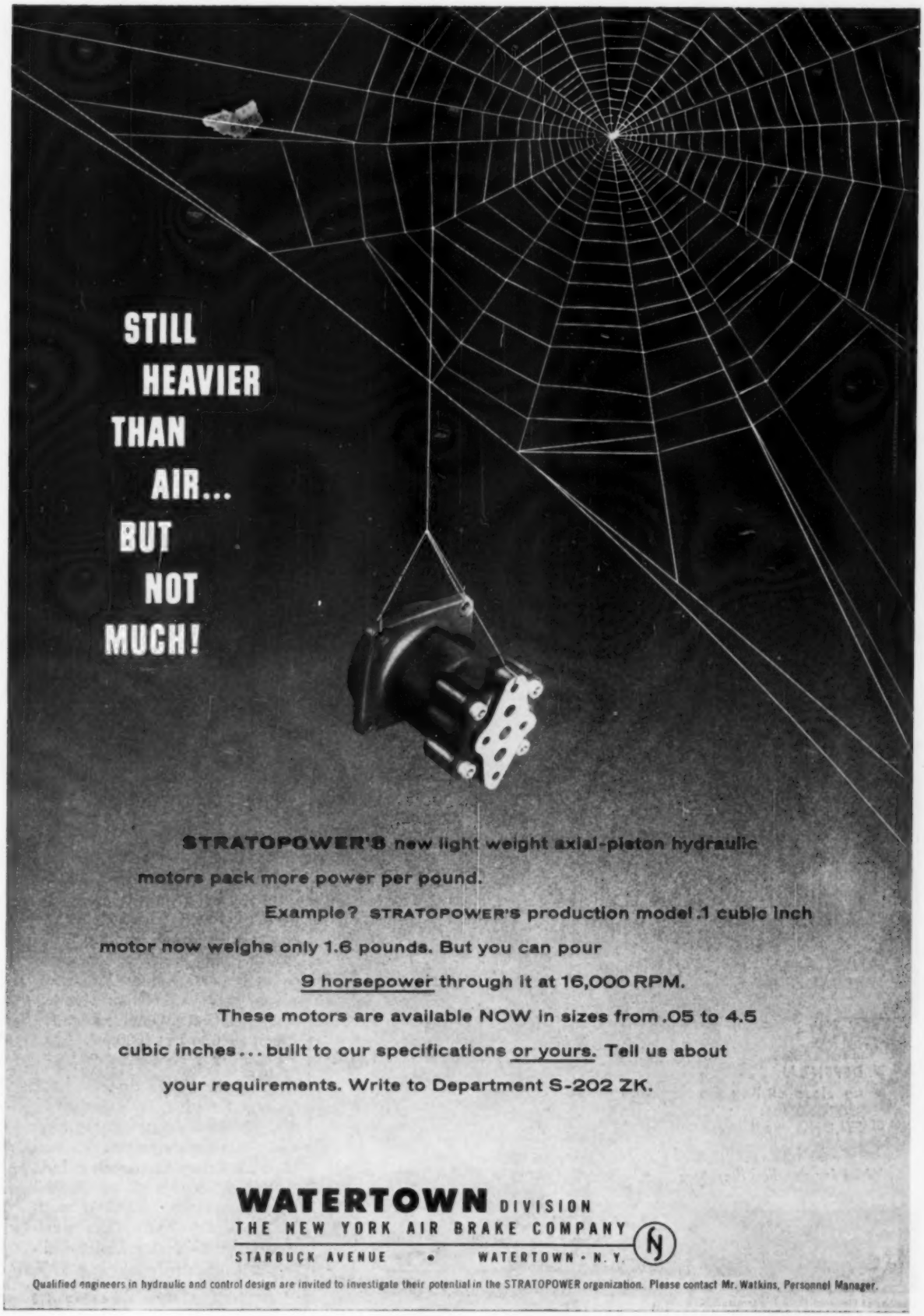
• **Balanced Rotary Valve**—Boulton Paul Aircraft, Ltd. has a




**CENTRAL ROTOR** of this rotary flow control valve has balanced static forces on it. The rotor configuration determines the dynamic forces on it. This is a 4-way, 3-position valve.

new type of rotary flow control valve to overcome break-out force and dynamic loading caused by

Continued on page 116




**STRATOPOWER'S** new light weight axial-piston hydraulic motors pack more power per pound.

Example? STRATOPOWER'S production model .1 cubic inch motor now weighs only 1.6 pounds. But you can pour 9 horsepower through it at 16,000 RPM.

These motors are available NOW in sizes from .05 to 4.5 cubic inches... built to our specifications or yours. Tell us about your requirements. Write to Department S-202 ZK.

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**designed into your**

**Compressed air system?**

Only with Adams Aftercoolers and Cyclone Separators can you get virtually **complete** removal of pipeline oil and water vapor — for these reasons:

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2. MORE COMPLETE SEPARATION OF OIL LADEN CONDENSATE. Adams Cyclone Separators have a unique conical design which produces efficient, 2-stage separation; first, heavier particles in the upper portion; then the finest particles are removed in the inner vortex formed within the conical area. This offers a constant high separation factor over a wide range of volumes—a characteristic not possible with baffle and other type separators.

**You pay no more** for superior Adams performance because of Adams specialization in these units for over 25 years. They have engineered the extra features into mass-production techniques which keep unit costs down.

**New Bulletin 714** merits your attention for fullest possible protection to your air-actuated equipment. Write for your copy today.

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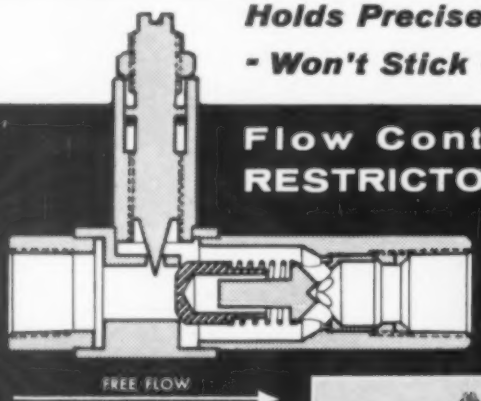
***Holds Precise Adjustment - Won't Stick Open***

**Flow Control RESTRICTOR VALVE**



- **DEPENDABLE — no close sliding fits**
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- **Sizes — ¼, ⅜, ½ & ¾ pipe (NPTF) — in stock**

**Manufacturers of Hydraulic Valves and Devices**

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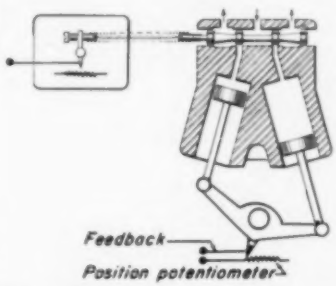
## FARNBOROUGH SHOW

fluid flow through valves. A central rotor, with portions cut away, is surrounded by a closely fitting, ported sleeve. Diametrically opposed ports balance static forces. The shape of the cutouts on the rotor governs the dynamic forces acting on it. Different shapes and areas of cuts balance the net force on the valve at the required value. The degree of overlap or underlap can be altered to vary sensitivity.

• **Double Piston Servo**—For actuating vanes of guided missiles, H. M. Hobson, Ltd. is producing a servo actuator using two moving pistons set at an angle to each

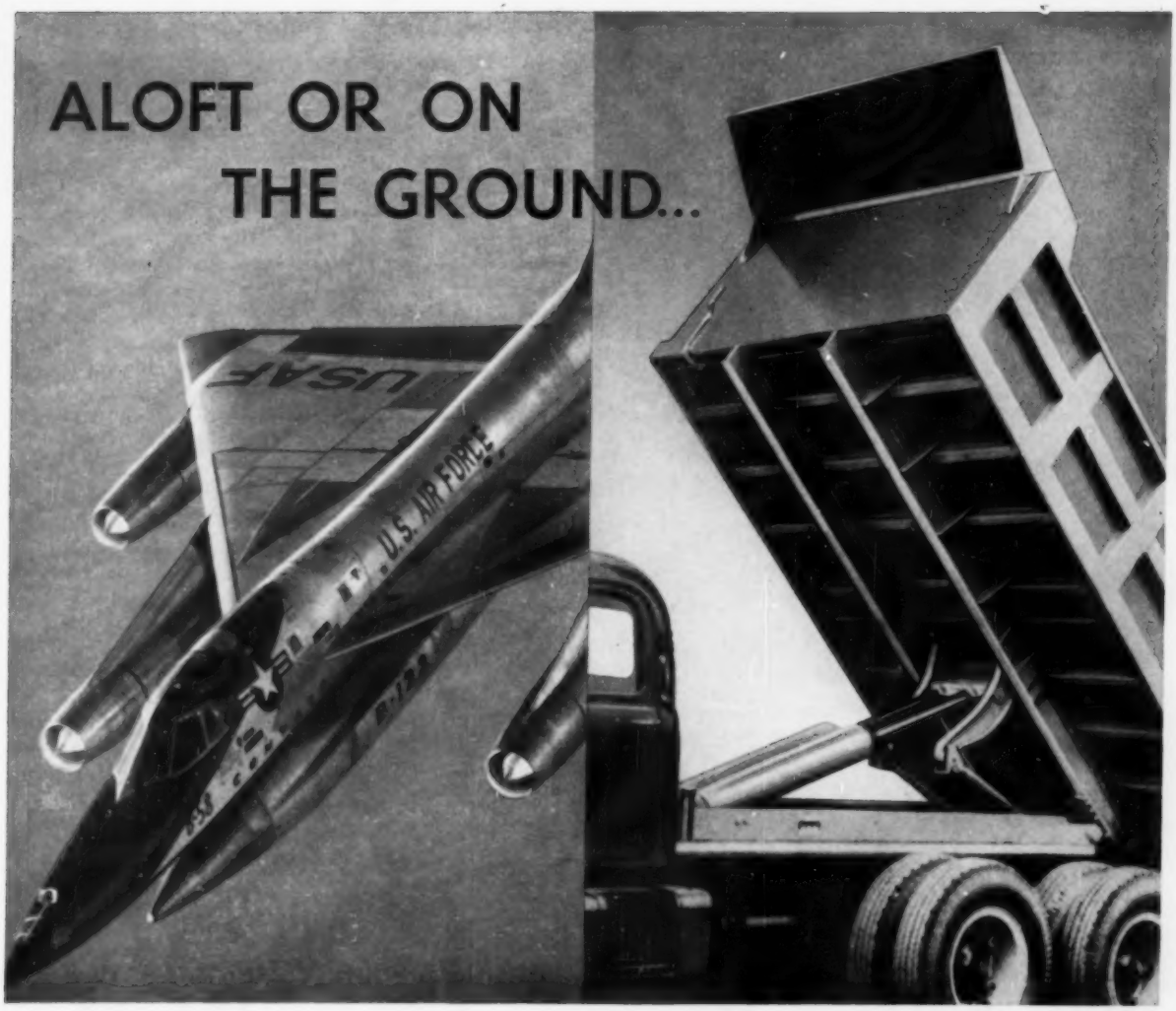



**TWO MOVING PISTONS** set at an angle to each other form the actuating mechanism for a single-stage servo actuator with an amplification ratio of 2000 to 1 at 4000 psi.

other. Their positions are controlled by a single-stage, sliding spool, which in turn is positioned by a transducer. This actuator operates with torque loadings up to 150 lb-ft and is designed for pressures from 1000 to 4000 psi. Electrical input to mechanical output shows an overall amplification ratio of 2000 to 1 at 4000 psi.

• **Tighter Filter Specs**—Satisfactory filtration, so important in today's fine-clearance servo systems, has been given much attention by Fairey Engineering, Ltd., Hydraulic Div., who has devised filters which exceed normal specifications. Previously filter specifications classified a 5-micron filter as one which would stop 98%

Continued on page 118




# Koppers Sealing Rings give ensured actuation!

**Koppers solves diverse and difficult sealing problems.**

Modern supersonic jets and dump trucks—as dissimilar as they appear—both depend on Koppers Sealing Rings for efficient hydraulic system operation. Koppers *Predictable Performance* Sealing Rings are used in a wide variety of applications . . . engineered to satisfy each requirement of both hydraulic and pneumatic sealing.

Koppers has the technological skill, gained through 38 years of experience, to meet the most critical performance requirements in any sealing application. Look to Koppers to solve your sealing problems. For an informative booklet on Metallic Sealing Rings write to: KOPPERS COMPANY, INC., 6011 Hamburg Street, Baltimore 3, Maryland.

A Koppers Sealing Ring is applied to a B-58 actuator.

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**SEALING RINGS**

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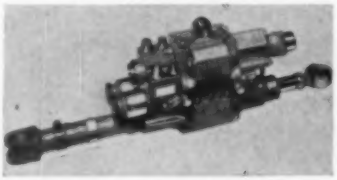
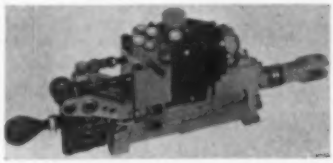
of contaminants larger than 5 microns. It did not specify the size of the remaining 2%. Such a filter could pass particles as large as 40 microns and still satisfy the specification. Fairey's more stringent specification classifies a filter as $X$ microns if it stops 99.5% of all contaminants larger than $X$ microns and does not pass particles greater than $1\frac{1}{2}$ $X$ microns. Tests show that a 2-micron filter to this specification suitably protects components having minimum working clearances of $2\frac{1}{2}$ microns.

• **Nosewheel Steering**—Among numerous exhibits at the Dowty Rotol booth was a nosewheel steering circuit consisting of a solenoid-operated steering valve and two drum switches (one for the pilot's control and one for the nosewheel). The valve and switches are coupled electrically to form a bridge circuit in which the out-of-balance is detected by a polarized relay. Operation of the steering control unbalances the bridge network. The resulting signal from the polarized relay actuates the steering valve to produce nosewheel movement until the circuit is again balanced by the follow-up drum switch on the nose-wheel. This arrangement is particularly suitable for aircraft where the pilot's position is far from the nosewheel. This would make mechanical follow-up linkage impossible. Interlocks prevent accidental operation of the steering when the nosewheel is retracted in flight. Other safety measures are provided which limit the angle through which the nosewheel can be turned and through which retraction can be started.



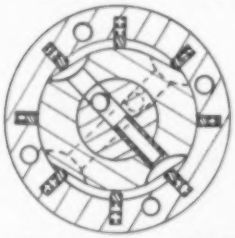
**DUAL INPUT SERVO ACTUATOR** by Dowty Rotol accepts both manual and electrical signals to actuate control surfaces. on VTOL aircraft.



**COMPACT HYDRAULIC POWER CONTROL** accepts the pilot's usual manual input. Yet it also responds to signals from the automatic stabilizing control system, which smooths the aircraft's flight path, without interfering with the pilot's commands.

A working demonstration of an advanced and compact hydraulic power control unit was part of the Fairey exhibit. The unit accepts the usual manual commands from the pilot and duplicates them hydraulically. Also it meets the demands of an automatic stabilizing computing system. Slight tendencies to yaw and pitch are sensed by rate gyros and automatically signalled through the servovalve to the actuators. These signals can be overidden by pilot input. ▼▼▼


**Hydro-Wheel®**
**MAKES PLATFORM UNITS SELF-PROPELLED**
**Gives 360° Steering**



- Simple, Safe, Easy-to-Install
- For Units of 1000 to 2000 lbs. Capacity
- Ideal for Narrow Aisles

Here is the new hydraulic wheel that makes "self-propelled" any platform lift unit of 1000 to 2000 lbs. capacity that uses an electrically driven hydraulic pump for lifting the load. Unit is installed by adding a valve and bolting on the Hydro-Wheel®, using the four bolt holes in the swivel block.
Hydro-Wheel® will rotate either forward or backward hydraulically, gives 360° steering. Safety valve protects battery and motor and prevents upsets by limiting size of obstruction wheel can climb.

**We also manufacture**

- Kingsbury Slipper Type rotary hydraulic pump for pressures to 2000 P.S.I.
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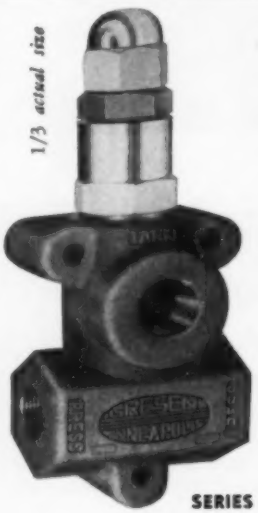

**TWO NEW RELIEF VALVES**

**SERIES J** (*High-lift ball and spring type*)
ONLY $16.50*

**SERIES PJ** (*pilot operated*) $19.50

Both series feature unique design for minimum *crack* to *full-flow* pressure differential and smooth, quiet operation. Both series, designed for *in-line* mounting, are available in ¾" and 1" pipe sizes and ¾", ⅞", and 1" tube sizes. Pressure adjustment range: 400-2500 psi for the PJ series, 400-2000 psi for the J series. Capacities up to 40 gpm (PJ series), 16-38 gpm (J series).

*Prices are FOB Factory and subject to trade discounts*

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**KEELAVITE**
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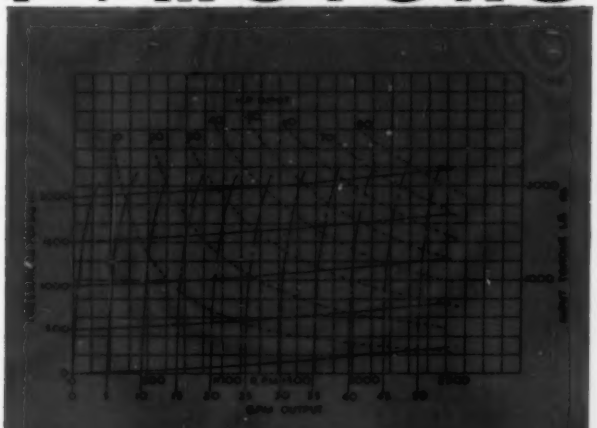
# GEAR PUMP / MOTORS

One of the new heavy duty gear pump/motors designed for high continuous rating.



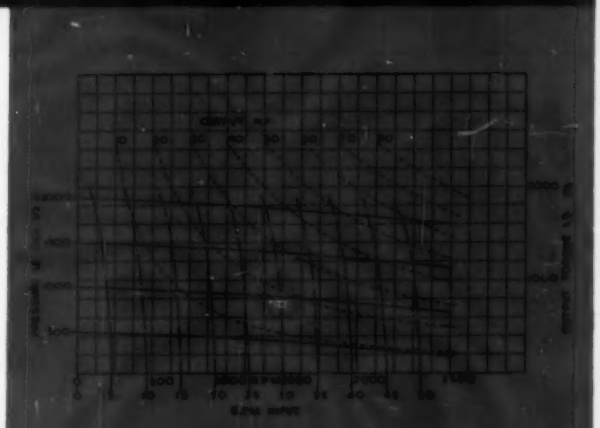
G221 GEAR PUMP

## KEELAVITE GEAR PUMP/MOTORS

Within the wide range of the KEELAVITE G SERIES of GEAR PUMP/MOTORS, there is a unit suitable for any industrial use. Used as pumps, output ranges from 2.25 gpm. to 180 gpm. Motor torque ranges from 10.5 lb. ins. per 100 psi to 785 lb. ins. per 100 psi.

## WHY THEY ARE BETTER

All of the KEELAVITE PUMP/MOTORS conform to a high standard of workmanship in manufacture, and are reversible without alteration in assembly. The whole range stems from six basic sizes and common components are used within each basic size. All units incorporate roller bearings.



G221 GEAR MOTOR

TYPICAL PERFORMANCE CURVES OF THE KEELAVITE G221 GEAR UNIT

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

*For full details write to—*

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**KEELAVITE HYDRAULICS LTD, ALLESLEY, COVENTRY, ENGLAND**
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**Fall Wiper Ring** SPRING LOADED

The Fall "CJ"* Wiper-Scraper Ring is Spring-Loaded causing Squeeze-Grip Action on the O.D. of the piston rod during entire cycle. This patented feature maintains a uniform, continuous pressure on the wiping edge of the ring at all times, stopping any buildup of foreign matter between the ring and the rod.

It automatically takes up wear, maintaining NEW RING PERFORMANCE. Available in diameters ½" through 13" for any commercial use. AN and MS numbers in use by the Military and Aviation industry since 1944. Manufactured in accordance with MIL-S-5049. (*Closed Joint)

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Est. 1925

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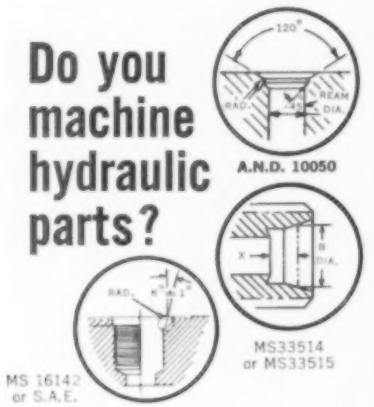


Standard cutters in stock for immediate delivery.
Write for catalog.

**SONNET Tool and Mfg. Company**
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# AEROSPACE NEWS

*from the fluid power field*

### Rucker builds hydraulic controls for Titan missile base

The Rucker Co., Oakland, Calif., will supply hydraulic and pneumatic power and control equipment for the Titan missile launching site at Home Mountain, Idaho. The equipment to be designed and built by Rucker will include actuators and control systems to operate silo doors and valves for three launching sites. Rucker previously received a similar contract for Titan complexes at Beale AF Base, Marysville, Calif.

### Parker Viton compound meets AMS 7279

A 90-durometer Viton compound for applications involving high temperatures and high static and dynamic pressures has been announced by Parker Seal Co., Division of Parker-Hannifin Corp., Culver City, Calif. Compound V498-9 meets specification AMS 7279 and can be used with hydraulic fluids, air, fuels, and lubricants to 500 F.

### Weatherhead names two, opens new plant

Nick L. Salvatore has been made senior application engineer of Weatherhead Co.'s Western Div., Glendale, Calif. He will be responsible for application engineering and design coordination in the West for all Weatherhead aviation valves and quick-disconnect couplings. He was a sales engineer for Hydromatics, Inc. Harold Fisher is now Atlantic District sales manager for Weatherhead. His territory includes Pennsylvania, Maryland, Delaware, Virginia, and North Carolina. He was field sales engineer for E. B. Wiggins, Los Angeles.

Weatherhead has opened a $100,000 facility for assembling and testing critical missile fluid power system components. Current work is on pneumatic valve and air tank assemblies for the Martin Bullpup missile. In the "White" room are instrument panels for electrical, pressure and temperature testing. The test panels are wall-mounted. All components are flush-mounted on stainless steel back panels. Working mechanisms are outside the room. Equipment in the room includes a leak detector for testing air bottles. Its capability is equivalent to 1 cc in 2 years. The compressor which supplies gases for testing pneumatic systems is outside the room. Gases are filtered to one micron before passing through stainless steel lines to the room. The air conditioning system for ultrasonic cleaning, white-room and gray-anteroom areas closely controls humidity and temperature. All parts for assembly in the white room are ultrasonically cleaned.

### Dalmo Victor appoints servo manager

Edwin A. Sweo has been appointed manager of servo engineering in the Engineering Division of the Dalmo Victor Co., Belmont, Calif. Sweo joined Dalmo Victor in 1956 as a member of Honors Cooperative Program, in which full-salaried Dalmo Victor engineers take part-time classes at Stanford University working toward advanced degrees. He is the first participant in the honors program to receive a degree (MSEE in January, 1959) and the first to receive a managerial appointment.

### Milner elected president at Electrol

E. Earl Milner, Jr. has been elected president and a director of Electrol, Inc., Kingston, N. Y. Milner was formerly assistant vice president of all four operating divisions of the Serrick Corp., Muncie, Ind. He brings to Electrol more than 20 years of experience in the engineering, production, and sale of aircraft parts and engines.

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*TubeXperience in action*

## 10 important reasons why Superior SAE Hydraulic Steel Tubing is your best buy

- **Ease in bending and flaring,** with no loss of ductility in storage or service, through use of 0.12% max. carbon content nonaging steel
- **Consistently uniform tubing** through careful inspection of raw material and tubing in process
- **Bright scalefree OD and ID** through controlled atmosphere annealing
- **Smooth ID** by mandrel drawing close to finish size
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- **Rust preventive treatment** of all tubing before shipment
- **All tubing boxed and wrapped** for cleanliness and to protect against bending and denting during shipment or in warehouse storage
- **A complete range of sizes** stocked and sold by leading steel service centers

FREE! Bulletin 39 which contains bending data, working and bursting pressures, and flow information. Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

*Superior Tube*

**The big name in small tubing**

**NORRISTOWN, PA.**

*All analyses .010 in. to ½ in. OD—certain analyses in light walls up to 2½ in. OD*

West Coast: Pacific Tube Co., Los Angeles, Calif. • FIRST STEEL TUBE MILL IN THE WEST

## SUBMINIATURE GAGE & ABSOLUTE PRESSURE SWITCHES

**now available from HAYDON**

**Proven in Helicopter Hydraulic Systems and in Rocket Motor Controls**

1590 GAGE PRESSURE SWITCH
3" x 0.937"
2½ ounces max.

Haydon Gage or Absolute Pressure Switches are easily tailored to specific pressure settings and environmental conditions. They have a pressure range of 10 psi to 3,000 psi, and have SPDT circuitry with sealed or unsealed snap-action switches.

These Pressure Switches meet applicable portions of MIL-E-5272, high and low temperature, shock and vibration.

1890 ABSOLUTE PRESSURE SWITCH
2¼" x 0.875"
2½ ounces max.

Write now for Bulletins 1590 and 1890, which give design specifications, electrical and environmental data, and applications.

HAYDON Switch INCORPORATED

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## CIRCLE SEAL

*9500 Series*

### MINIATURE LEAKPROOF SHUTOFF VALVE

LEAKPROOFMANSHIP...a word not found in Webster's but coined to convey our philosophy (and we live up to it, too) of perfect leakproof sealing. Not merely braggadocio but an operational certainty. It is said that the very best things come in small packages and this is especially true of the Circle Seal 9500 Series Valves. Miniaturized at no sacrifice in quality, these valves operate from 0-2000 psi while maintaining all the features that have made the name CIRCLE SEAL synonymous with valve quality.

- **Leakproof in vacuum or pressure service**
- **Straight through flow**
- **Positive position indication**
- **Provides accurate metering**
- **Effortless opening and closing**
- **"O" Ring seals virtually eliminate wear**
- **Convenient 90° "T" handle**

**CIRCLE SEAL PRODUCTS COMPANY, INC.**
2181 East Foothill Boulevard • Pasadena, California
*Military Service:*
**JAMES, POND & CLARK, INC.**

CIRCLE® SEAL
*precision valves*

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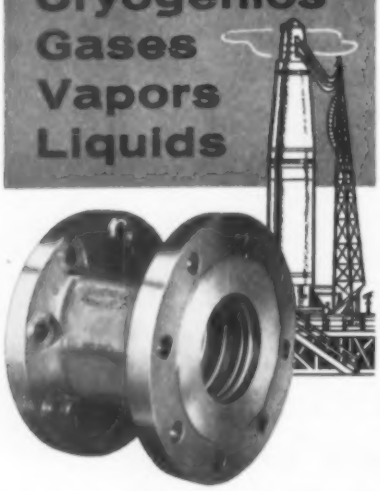
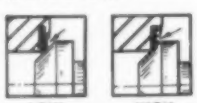
SEALOL
Check Valves
for
POSITIVE CONTROL
of
Cryogenics
Gases
Vapors
Liquids



**New soft-seat design** insures leak proof action over a broad pressure range

Low pressure (1 pound or less) seats the poppet on a resilient disc inset in the body. As pressure increases, the resilient disc is radially displaced and a metal to metal seat results.




**Specifications** — sizes from ¼" to 6" and larger. Materials are steel, stainless steel, aluminum, brass or as required. Pressures to 6,000 psi. Temperatures from —425°F to +400°F. Available with pipe or tube fittings or flange ends as required.

**Fully qualified** — all models meet or exceed MIL-V-5524A. Sealol Check Valves are used aboard newest atomic subs, in rocket fuel-mixing plants, launching equipment and numerous industrial applications.

**Applications** — current uses include the Polaris launching system and the Atlas fuel handling system. Also at the Liquid Rocket Plant of the Aerojet-General Corporation, the Titan fuel handling and mixing systems.

Send for Bulletin HP02 or call S. J. Biello at STuart 1-4700 (area code 401) for detail information.

SEALOL INC.

**1511 Post Road, Providence 5, R. I.**

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# AEROSPACE COMPONENT DATA

### *Oil Filtration Unit . . . has 0.5 or 3.0-micron filtration*

Change filtration level by replacing filter element and resetting panel valve. Flow is 2.2 gpm for 0.5 micron filtration and 3.8 gpm for 3.0 micron filtration. Signal light on panel indicates when filter should be changed. By adjusting two panel-mounted valves, four different modes of operation can be selected. Oil may be pumped from an external source, filtered, and returned to the original or another external point. Or after filtering, it can be stored in the 20-gal internal reservoir. Oil may be pumped from the internal reservoir, filtered, and directed to an external container. Oil may be continuously filtered internally. Operation is automatic after filter is turned on. Dimensions are 40⅝" x 37" x 22⅛". Has constant displacement, gear type pump. Reservoir has level indicator. Quick disconnect connections are panel mounted.—*Kidde Aero-Space Div., Walter Kidde & Co., Clifton, N. J.*

Circle **500** on Time-Saver Card

### *Electrohydraulic Servovalve . . . weighs .8 lb.*

Model 10-E delivers to 2 gpm. Has zero-lapped 4-way valve, and frictionless, symmetrical spool boost system. Boost system uses balanced hydraulic bridge. Fixed upstream orifices form two arms. Two nozzles at end of spool form two arms. Each nozzle is restricted by end of a drive rod. Difference in restriction of two nozzles provides pressure differential at spool drive chambers. Differential forces spool to central position between two drive rods. Force motor strokes drive arms through stainless steel diaphragms. Diaphragms serve as pivots and as high-pressure hydraulic oil barriers. High spool drive stiffness. Low null shift over large temperature and pressure ranges.—*Pegasus Laboratories, Inc., Berkeley, Mich.*

Circle **501** on Time-Saver Card

### *High Temperature Gas Bellows . . . for airborne APU systems*

Machined bellows for 1400 psi with gas temperatures to 1200 F, are used in pairs. Bellows assemblies allow 0.11" for 5" of angular offset movement to relieve expansion and contraction in lines due to change in gas temperature. Application determines material.—*Hydrodyne Corp., North Hollywood, Calif.*

Circle **502** on Time-Saver Card

### *Constant Speed Drives . . . are split system*

Bulletin A-5246 describes four split-system, constant-speed drives for missile and aircraft applications to supply constant speed, shaft power. The four systems are governor-controlled and throttle-controlled motor, and flow-controlled and by-pass-controlled pump. Most frequent application of these systems is driving a-c and d-c generators. Other applications include gas compressors, blowers, fans, centrifugal pumps, and actuators. Utility hydraulic power may be provided from the engine-mounted pump to operate flight controls or accessories. Schematic diagrams, performance characteristics, and operating principles are

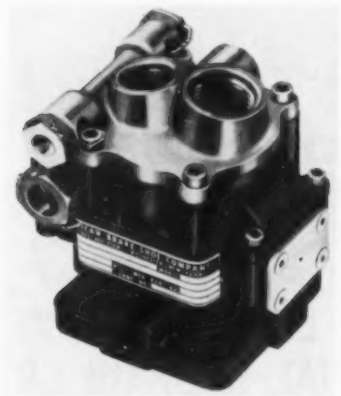
given for each type. Governor-controlled motor: constant pressure fluid is provided by a pressure-compensated, variable pump to a variable motor. Governor controls motor displacement. Throttle-controlled motor: constant pressure fluid is provided by a pressure-compensated, variable pump to a throttle valve and then to a fixed motor. Flow-controlled pump: constant flow is provided by a flow-compensated, variable pump to a fixed motor. Pressure varies with load. Pressure drop across a fixed orifice changes pump delivery. By-pass-controlled pump: Constant flow is provided by a fixed pump with a by-pass control to a fixed motor. Engine speed range, overloads and response, weight, size, and efficiency are discussed. Pump and motor performance and envelope data are given.—*Vickers Incorporated, Detroit, Mich.*

Circle **503** on Time-Saver Card

### *New Airborne Hydraulic Pump*

### *. . . weighs 2.3 lbs*

Delivers 5 gpm at 12,000 rpm and 3000 psi with maximum displacement of 0.10 cu. in. The AP05V is a single-stage, variable-volume, cam-actuated pump with



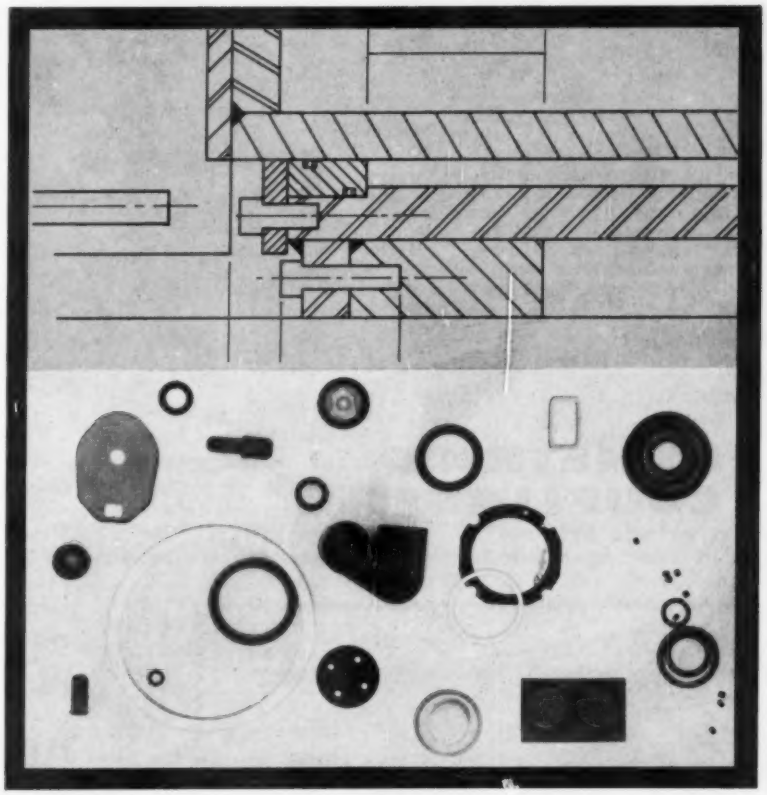
pressure-compensated control. Response characteristics meet and exceed those required by MIL-P-7740B and MIL-P-19692. Volumetric efficiency is over 95%. All rotating parts are hydraulically balanced. Pump does not require universal drive nor anti-friction thrust bearings. Direct oil entry permits longer periods of cavitation without noticeable wear, and top performance is maintained up to 40-micron contamination.—*Kellogg Div., American Brake Shoe Co., New York, N. Y.*

Circle **504** on Time-Saver Card

**Continued on next page**


## *PARCO PROBLEM PROBERS*

## ???...SPECIAL SILICONE MOLD COSTS ELIMINATED



!!! If the cost of furnishing special oversize molds has deterred you from using silicone custom molded rubber parts and "O" Rings in your product design, Parco has a ready answer for this problem. Parco scientists and engineers have now developed new compounding methods and production techniques which make it possible to produce both silicone molded rubber parts and "O" Rings in molds previously designed for standard parts. This eliminates the need for special oversize molds to allow for shrinkage during molding. ○ These new silicone compounds, with mold shrinkage comparable to that of organic polymers, meet AMS and MIL Specifications in durometer hardness ranges from 50 to 80. Operational temperature range of the silicone products is, conservatively, from −70 to +480° F. ○ Enjoy the advantages of using silicone rubber products minus the extra cost of the specialized tooling formerly required. Consult with Parco engineers.

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*Please send the Parco O-Ring Data Chart to:*

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Circle **141** on Time-Saver Card

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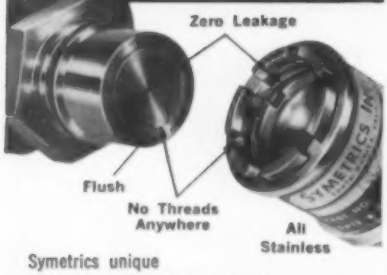


Symetrics unique self-sealing disconnects have zero leakage during disconnect . . . no air inclusion during connect. Full pressure after disconnect. No exposed seals after disconnect . . . no contamination. Housing is one piece with minimal size. Positive push-pull lock may be handled with one hand or remotely. 3000 psi. Exceeds MIL-C-25427.

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3100 Airport Avenue, Santa Monica, Calif.

## AEROSPACE COMPONENT DATA

### *Container Relief Valve . . . protects airborne shipping and storage containers*

Vent and breather valve P7-637 is lightweight, highly sensitive, for low pressure. Maintains slight internal pressure in container to prevent free breathing. Also maintains equilibrium between internal

and external pressure to prevent explosion or implosion of sealed containers. With a 1-psi cracking pressure, it will pass 50 scfm at 2-psi inlet pressure. Operates at −65F to 180 F, and maintains a consistant cracking pressure of 1 psi, ±15%. Valve is aluminum, for a 1-5/16"-connection. When closed, maintains a dead tight seal to retain internal container pressure.—*James, Pond & Clark, Inc., Pasadena, Calif.*

Circle **505** on Time-Saver Card

### *Flow Sensor . . . for any liquid*

Viscosity, density, and temperature don't affect continuous measurement. Magnetic pickup supplies ac voltage or frequency outputs directly proportional to liquid displacement. Readout through standard instrumentation. For temperatures from sub-zero to 350 F. Operating pressures to 4500 psi. Displacement is .2232 cu. in./rev. Speed range is 50 to 8000 rpm. For 11.16 cipm to 7.73 gpm. Accuracy is ½ of 1%. Model 9005.—*Pneudraulics, Inc., Montclair, Calif.*

Circle **506** on Time-Saver Card

### *Pure Beryllium Tubing . . . for aircraft, missiles*

Sizes and properties of beryllium tubing are given in 4-page Memorandum No. 26. High modu-

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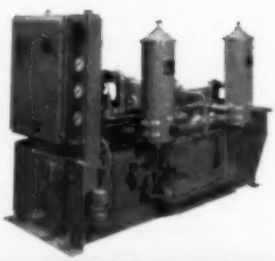

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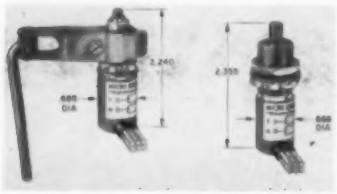
lus of elasticity makes it useful in aircraft and missiles where structural rigidity is required. It is light (about half the weight of aluminum) and has high strength (greater than low carbon steel). At room temperature tubing is about as brittle as cast iron. Longitudinal elongation is 36.7%, transverse elongationa is 1.4% at 300 C. Size range for as-extruded tubing is 0.250 to 2.000" OD with wall thicknesses from 0.016" and heavier. Standard lengths are 6 to 17 ft depending on cross-sectional area.—*Superior Tube Co., Norristown, Pa.*

Circle **507** on Time-Saver Card

### *Sub-miniature limit switch . . . housing is sealed*

Data sheet 171 describes 11/16" diameter limit switch, series 400EN. Housing is evacuated and filled with an inert gas under pressure and sealed to insure constant operating characteristics. For aircraft, missile, and mobile application. Switch meets immersion test requirements of MIL-E-5272A, Pro requirements of MIL-E-5272A, procedure 1, and has a temperature range of −65 F to 250 F,



weighs 2.50 oz., for 28 vdc. Available with plunger actuator or linkage-lever actuator. Data sheet has diagrams, photographs, circuitry, electrical ratings, and mechanical characteristics.—*Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.*

Circle **508** on Time-Saver Card

### *400-Cycle a-c Motor . . . for aircraft and missiles*

Meets latest MIL specification. Product data catalog 107-2 lists lightweight, precision motors for electromechanical, linear and rotary actuators, servos, pumps, and valves. Horsepower ratings from 1/80th to 2 hp. About 11,000 rpm, totally-enclosed, non-ventilated or fan-cooled. 400-cycle brake operates directly from power supply, in parallel with motor windings.—*Electro-Mechanical Division, Lear Inc., Santa Monica, Calif.*

Circle **509** on Time-Saver Card

**Actual unretouched photos of MARSH 616 Square-Shouldered Cups and Square-Shouldered Flange used in the test below**

**MARSH 616** gives the most rugged packing for severe operating conditions — sealing petroleum hydrocarbons and aqueous or non-aqueous base fire-resistant fluids. Temperature range: −65° to +212° F. Made of . . .

***Thermo*** — the finest retan packing leather — condensed in area and thickness to create toughness and higher tensile strength with . . .

***Elastomer*** impregnation with polymerization within the leather structure. The resulting polymer has *no melting point* and cannot be removed by any hydraulic fluid.

**RECENT RESULTS IN PYDRAUL* F-9 PHOSPHATE ESTER BASE FLUID show the "universality" of the MARSH 616 packings.**

1. LESS than 2% swell by volume.
2. STATIC SEALING for 12 months at 5000 psi with no leakage.
3. CYLINDER TESTS under load, with temperatures up to 130°F—1,000,000 strokes with positive seal and no packing damage.
4. SATISFACTORY field application.

NOTE: Complete test reports on the Pydraul test results are available upon request.

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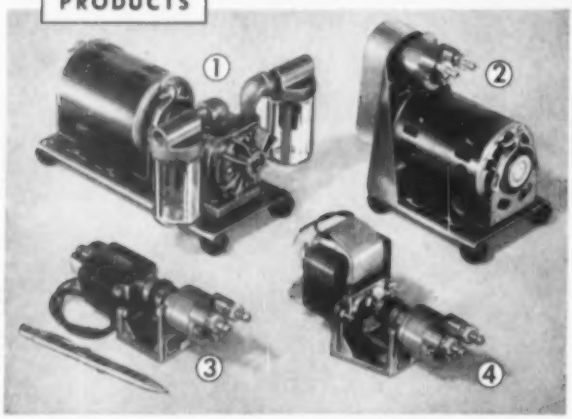
ROTARY AIR
GAST
PRODUCTS

NEW for 1960




TWO TYPES OF MINIATURE OIL-LESS

GAST rotary vane VACUUM PUMPS and AIR COMPRESSORS

① Model 1030-V110-206 Vac. Pump, 1/20 h.p. Up to 1 c.f.m.; to 15" vac.

② Model 0330-V112-206 split phase 1/20 h.p. motor, .48 c.f.m. Up to 20" vac. or 15 p.s.i.g.

③ Model 0330-V102A-151 series wound motor. Up to .67 c.f.m. To 20" vac. or 10 p.s.i.g.

④ Model 0330-V110-202 shaded pole motor. Up to .35 c.f.m. To 20" vac. or 10 p.s.i.g.

⑤ (Below) Model 0630-P103 Compressor, up to .6 c.f.m. To 25 p.s.i.g. or 24" vac.

FOR ORIGINAL EQUIPMENT APPLICATIONS ON CONTROLS, INSTRUMENTS, BUSINESS MACHINES, LAB EQUIPMENT

Now — where space is very limited — you can provide moderate vacuum or pressure with one of these two types (3 series) of Gast semi-miniature Air Pumps.

They run entirely without oil. Carbon vanes lubricate themselves, producing a completely oil-free air blast or exhaust. Rotary design is simple, trouble-free and positive in air displacement.

The largest Model 1030 (1 above) delivers up to 1 c.f.m. running open at 3450 r.p.m. Model 0630 (5 below) has identical exterior, delivers up to .6 c.f.m. Smaller type 0330 (2, 3, 4 above) is shown with a choice of motors to suit various pump applications, both a.c. and d.c. With a rotor diameter smaller than a penny, Model 0330 produces up to .67 c.f.m. (open) at 6000 r.p.m.!

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See Catalog in Sweet's Design File

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- AIR MOTORS TO 7 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

"Air may be your answer!"

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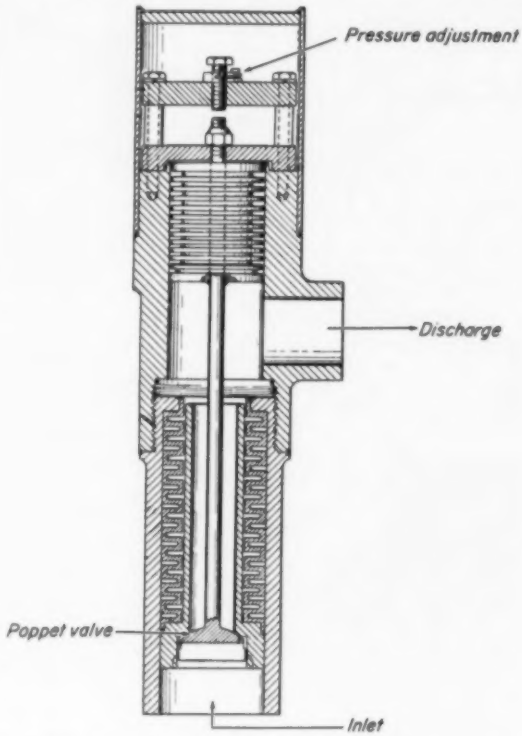
# FLUID POWER PATENTS

## Inverted Relief Valve

Valve has no springs and requires no static or dynamic seals. Its seat mounts on a heavy-duty bellows. As inlet pressure increases, the bellows compresses. A poppet valve moves with the bellows until the valve




stem hits an adjustable stop. If pressure continues to increase, the bellows compresses further, moving the valve seat away from the poppet.

The smaller bellows on the top serves two purposes. It seals the stem, and it balances the valve against backpressure. Surface area of the bellows is equal to the area of the valve seat. Therefore any backpressure is applied to equal areas.

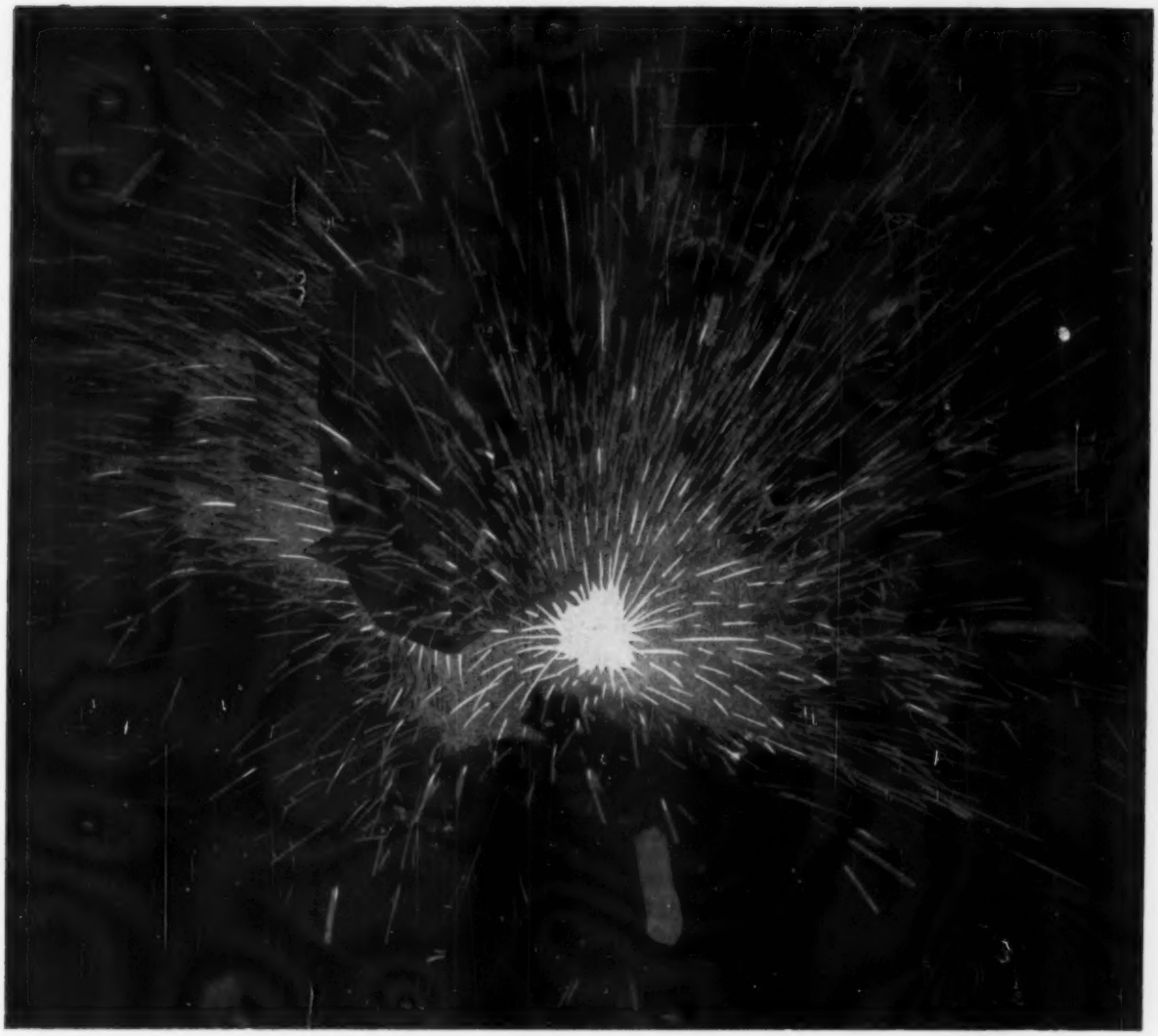
Clearance between the bellows and the valve body prevents friction.

*U. S. Patent No. 2,845,088 M. A. Crausman and D. M. Pattarini, assigned to Target Rock Corp., Huntington, New York.*

## Backpressure Valve

The valve maintains pressure in the return line to prevent cavitation and provide a rigid system. It was designed for hydraulic steering systems where pressure

Continued on page 128



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For many years the precise control associated with 'VSG' variable delivery hydraulic pumps and transmission gears has proved invaluable to the Steel Industry.

Mill and drawbench drives, sawing and measuring tables, processing machines and manipulators are a few examples of the many applications of 'VSG' equipment.

The Steel Industry is but one of many industries which 'VSG' has now been serving for over fifty years.

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# SPECIAL CYLINDERS

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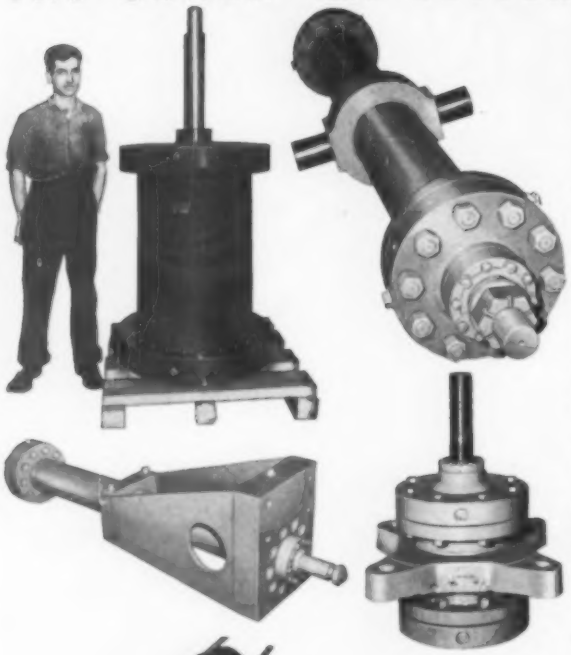
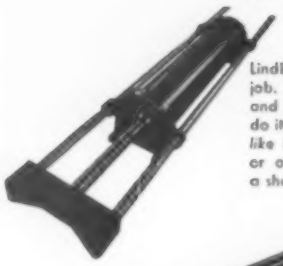


If someone tells you to shove it, Lindberg will build a cylinder to do the job. We've built specials—real odd balls and we have the kind of a shop that can do it at prices you will find interesting. We *like to build specials!* Send us your prints or other description for fast action with a sharp pencil.



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BULLETIN H-101 —2000 PSI "H" LINE
BULLETIN A-101 —HEAVY DUTY "A" LINE

**LINDBERG** AIR and HYDRAULIC DIV.
*TEER-WICKWIRE & CO.*
1802 WILDWOOD AVE. • JACKSON, MICHIGAN

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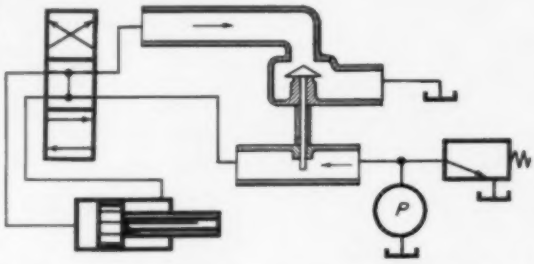
drop across the cylinder is high, creating cavitation noise. The valve maintains a fixed ratio between the inlet and return pressure.

• **Operation**—With the control valve in neutral, pump output flows through the valve to tank with very



little restriction. When the control valve shifts to extend or retract the cylinder, pump pressure, acting on the poppet valve stem, lifts the poppet and restricts return flow from the cylinder.

Pressure drop across the cylinder is constant and is directly proportional to the ratio of area of the valve seat to the valve stem.

*U. S. Patent No.* 2,845,901 *by Stanley I. McDuff, assigned to Bendix Aviation Corp., Delaware.*

### *Other Patents Issued*

**HYDRAULIC PUMP**

*No.* 2,910,948 *by John L. Betzen, Hereford, Texas.*

**HYDRAULIC ACCUMULATOR**

*No.* 2,912,004 *by George C. Meredew assigned to Bernard Bercovitz, Toronto, Canada.*

**FLOW CONTROL VALVE**

*No.* 2,910,970 *by Morton M. Coker, assigned to Caterpillar Tractor Co., Peoria, Ill.*

**4-WAY VALVE**

*No.* 2,912,007 *by Clarence Johnson, South Euclid, Ohio.*

**TRACER VALVE**

*No.* 2,914,292 *by Axel Anderson, assigned to Sunstrand Corp., Rockford, Ill.*

**CHECK VALVE**

*No.* 2,912,002 *by Carl A. Miller, assigned to Economics Laboratory, Inc., St. Paul, Minn.*

**FLOW DIVIDER**

*U. S. Patent No.* 2,910,085 *by Osker H. Banker, assigned to New Products Corp., Skokie, Ill.*

**VARIABLE DELIVERY PUMP**

*No.* 2,910,943 *by George E. Marshall and Gordon Inker, assigned to Stothert & Pitt, Ltd., Bath, England.*

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All Sizes and Quantities of Viton, Butyl, Teflon and Silicone Now in Stock.

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Full line flow into "Y" socket. Metering orifices in socket permits supplying required air for one to six outlets.

**LIQUID OXYGEN**

Double shut-off type with modified bayonet locking. Metal to metal seals operating against 75 PSI, minus 310°F. Meets A. F. specs.

**MINIATURE COUPLING**

Weighing only 1/4 oz. with 7/16" OD and 1-1/8" OAL, this aluminum coupling designed for 1/8" tubing connections to missile motor. Easy Pulomatic ball detent locking action.

**COMB. OXYGEN & ELECTRICAL**

Connects oxygen and communications wiring to pressurized flying suits, survival kits and capsules. Seal engages and disengages before electrical contacts.

**FUEL CHARGING**

Straight-thru type with fast Pulomatic ball detent locking. Unique design permits high pressures, light weight construction and flush mounting.

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Circle **115** on Time-Saver Card

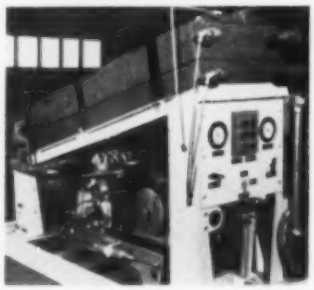

# NEW PRODUCTS

Continued from page 52

### MECHANICAL SEPARATOR

Refrigerated separator dries moisture and oil from air, nitrogen, and helium. Single and double models.

**Specifications:** Handles gases from 3500 to 12,000 psig, at flows from 50 to 250 scfm. Cools air to 35 F with incoming temperatures as high

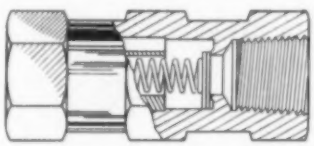


as 105 F. Reduces moisture and oil content up to 80%. Maintains dewpoints of −50 to −65 F. When desiccants are used downstream to reduce dewpoint further, adsorbent life is increased 6 times.
*Cardair, Div. Marmon-Herrington Co., Inc., Chicago.*

Circle **310** on Time-Saver Card

### CHECK VALVE

One-piece body. Disc is only moving part. Disc has soft surface. Foreign matter does not affect valve. For air, oil, water.



**Specifications:** Burst pressure is 20,000 psi. Opening pressure is 2-8 psi. In brass in ¼", ⅜", and ½" female pipe.

**Designation:** 900 Series—*Bodnar & McDermott Mfg. Co., Mt. Vernon, N. Y.*

Circle **311** on Time-Saver Card

### AIR MOTOR

Heavy, aluminum gear case and motor housing. All moving parts mounted in ball or needle bearings. Reduction gears are cage-mounted

Continued on page 132


IN A RUT?

OR IN THE GROOVE?

.... If you're in a rut about things hydraulic, we think we can put you in the groove! For the finest in custom cylinders and valves.... call, we'll talk !!!!!

**UNIVERSAL HYDRAULICS**

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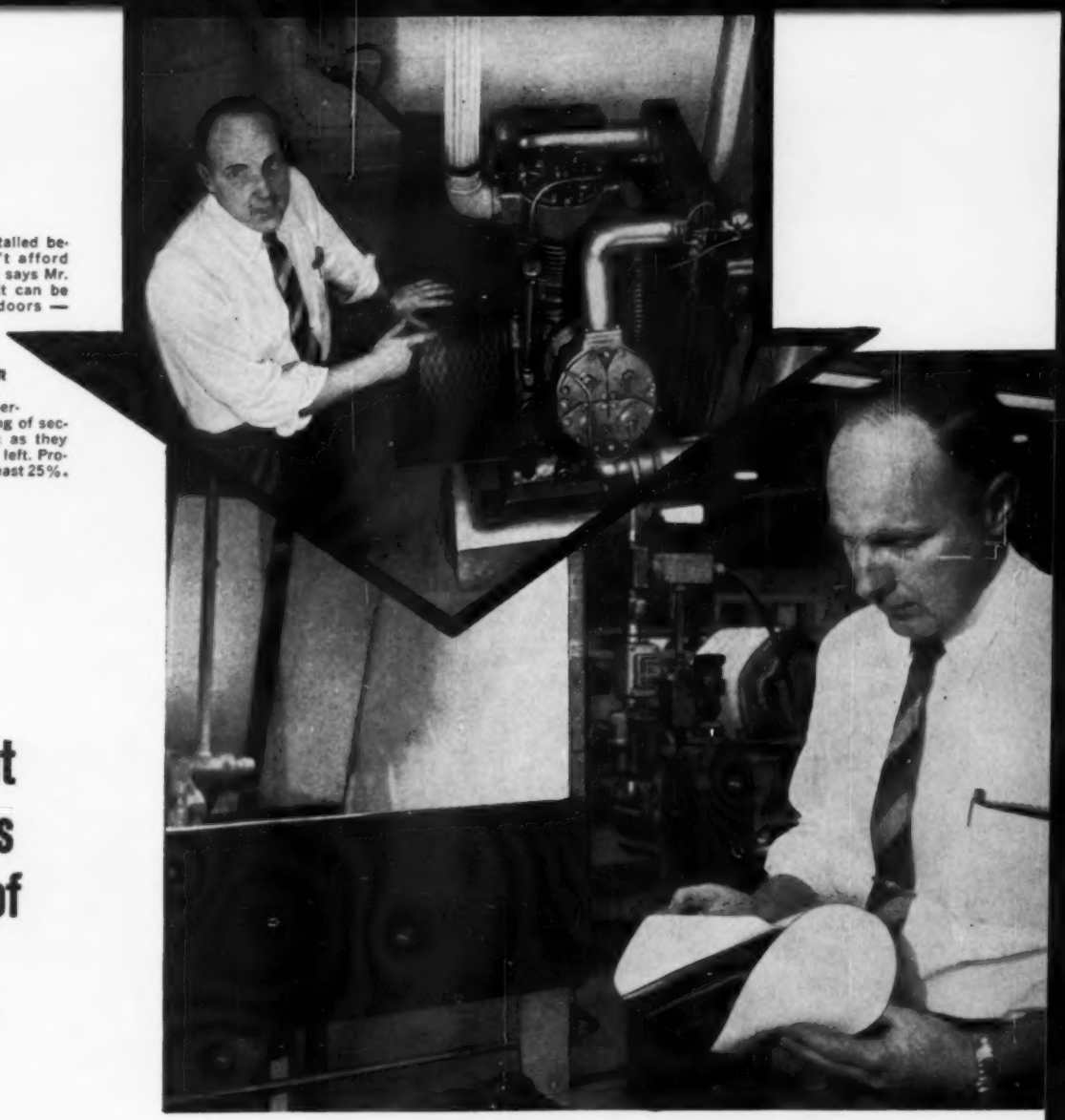


**LE ROI 50S2** was installed because Bowes couldn't afford compressor downtime, says Mr. LaFara. Air-cooled unit can be used indoors or outdoors — needs no plumbing.

**FINISHED TIRE REPAIR SECTION** is inspected. Compressed air now permits automatic spraying of sections with liquid latex as they pass through booth at left. Production increased at least 25%.

# This plant minimizes the risk of "no air - no work" with a

# LE ROI 50HP STATIONARY COMPRESSOR

A dependable compressor headed the list of critical needs when Bowes Seal Fast Corp., of Indianapolis, Ind., merged two plants under one roof. A Le Roi 50S2 two-stage compressor provides this vital dependability . . . and all the compressed air needed to produce over 2000 various items for the upkeep of cars, tires, and tubes.

James S. LaFara, Plant Manager, reports that the Le Roi unit delivers 210 cfm at 125 psi . . . operates 75% to 80% of 8- to 16-hour production days, five days a week, and supplies almost 100% of all the compressed air needed. Down-time, he adds, is at a minimum, and maintenance costs are below those of two smaller compressors which the Le Roi replaced, and which now serve only as standby units.

Look what this Le Roi 50S2 does! It provides air to spray tire-repair sections (boots) and tubeless-tire repair plugs with a mixture of liquid soap and water. The unit powers latex spraying machines, and blows scraps from tube-patch cutting machines. Other uses include air for lead moulding equipment, nut-driving units, cleaning vents on chemical filling machines, and for the plant's fire-protection system.

Are you looking for a "dependable" compressor? Check the complete line of Westinghouse unit-type and Le Roi stationary air compressors — from ½ to 100 hp. Contact your Le Roi distributor, or write to Le Roi Division, Westinghouse Air Brake Co., Sidney, Ohio.

SC-98

**LE ROI STATIONARY COMPRESSORS**

PORTABLE AND TRACTAIR® AIR COMPRESSORS • STATIONARY AIR COMPRESSORS • AIR TOOLS

Circle **87** on Time-Saver Card

## NEW PRODUCTS

for support at both ends of gears. Delivers peak horsepower as load builds up, motor slows to ⅔ free speed. Delivers peak torque just before stalling.

**Specifications:** Power source is 90-psi air. Maximum outputs from 90 to 1800 rpm. Stall torques from 9 to 190 ft-lb. 1.5 hp from unit 12" long, 3¼" dia.

**Designation:** 71J-5—*Gardner-Denver Co., Quincy, Ill.*

Circle **312** on Time-Saver Card

### PERMANENT MAGNET TORQUE MOTORS

For first stage valves. Differential or series excitation. Motors have different values of internal stiffness. High ratio of internal stiffness to inertia. Both soft-iron or Radiometal stator units have a pair of windings. Two permanent magnets separate cores. Cores and magnets surround armature. Small ballrace in end plate supports shaft at each end. End plates have mounting surfaces.

**Specifications:** Typical model responds to 0.1% full current. Its maximum deflection is ±0.15 radians. Maximum torque is 1500 gm-cm in central position. Deflection sensitivity (differential excitation) is 0.0092 radians/ma. Torque sensitivity is 7.6 gm-cm/ma. Hysteresis is less than 1.5% amplitude. Natural frequency, 500 cps. 510-ohm windings. Weighs 4⅛ oz.—*De Havilland Propellers Ltd., Hatfield, England.*

Circle **313** on Time-Saver Card

### TEFLON TAPE

Pipe-joint sealer remains plastic. Joints can be drawn up to maximum tightness. For all types of piping.

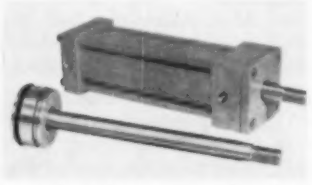
**Specifications:** Widths are ¼", ½", ¾", and 1". Withstands temperatures from −250 to 500 F.

**Designation:** Thred-Tape—*Crane Packing Co., Morton Grove, Illinois*

Circle **314** on Time-Saver Card

### CYLINDERS

For air and low-pressure oil. One-piece aluminum piston. Hard-chrome-plated rod. Aluminum end caps. Seamless brass tube. Block



Vee seals and wiper on rod and piston. Adjustable cushions either end. Mountings are flush, foot, front and rear flange, clevis, and pivot.

**Specifications:** 1¼" to 3½" bore.

**Designation:** Cost Saver—*Mo-Bar Hydraulics Co., Crystal Lake, Ill.*

Circle **315** on Time-Saver Card

Continued on page 134


# NEED BIG VALVES?

## *Why Buy Specials*

H-P-M makes heavy duty directional and pressure control valves in standard sizes for large flows. 3000 psi; up to 6" capacity. Designed for greater flow, less pressure drop, better service.

Valve bodies, spools and control elements are easily modified for your specific needs. Patterns — even castings — are often available for fast delivery, lower cost. For complete information, write or call H-P-M — designers and builders of heavy duty hydraulics since 1877.

H59

**THE HYDRAULIC PRESS MFG. COMPANY**

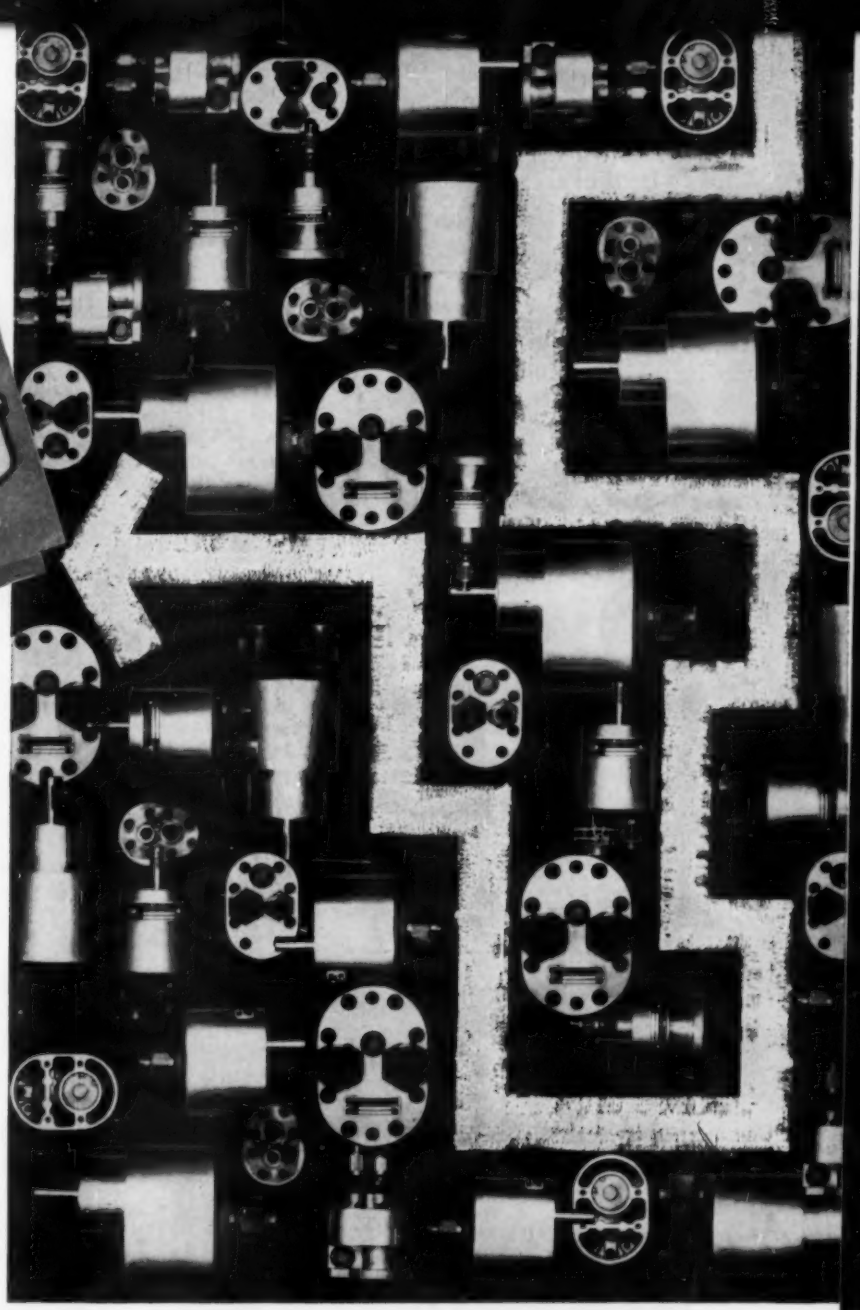
A Division of Koehring Company • Mount Gilead, Ohio, U.S.A.

Circle **74** on Time-Saver Card




Circle **46** →

# your guide to *the gear pump* for your application



*This new catalog is an invaluable directory to no less than 129 pump-and-electric-motor-combinations — any and all available off-the-shelf!*

Searching for gear pumps with top volumetric efficiencies? Do your performance requirements fall into one of these three major groups?

- Eastern 1200 series — up to 1.6 gpm — pressures to 800 psi
- Eastern 100 series — up to 5 gpm — pressures up to 1500 psi
- Eastern 700 series — up to 9.8 gpm — pressures up to 1500 psi

If one or more of these performance ranges measures up to what you need, save hours of searching your way through the gear pump maze — send for catalog 810 now!

***Other Eastern products:***

- **hydraulic motors**
- **positive displacement pumps**
- **centrifugal pumps**
- **aircraft pumps**

**EASTERN INDUSTRIES, INCORPORATED**
Hamden, Connecticut

Circle **94** on Time-Saver Card

*If it's a pressure gauge or dial thermometer*

**MARSH MAKES IT!**

No name is so expressive of accuracy and dependability as the name, Marsh, on a pressure gauge or dial thermometer. Types, ranges and styles are endless. To know the scope of Marsh Instruments—

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Division of Colorado Oil & Gas Corporation
Marsh Instrument & Valve Co., (Canada) Ltd.
8407 103rd St., Edmonton, Alberta, Canada
Houston Branch Plant, 1121 Rothwell St.,
Sect. 15, Houston, Texas

# NEW PRODUCTS

### VITON-TO-METAL SEALS

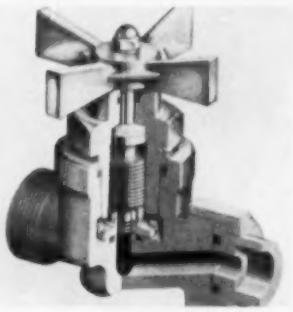
Viton-based compound is bonded to machined metal parts. Resulting seal can be precision-ground to seal against flat or conical surfaces. Seals can be used as poppets, swing checks, valve seats, flappers, and pistons.—*Stillman Rubber Co., Culver City, Calif.*

Circle **316** on Time-Saver Card

### VALVES & FITTINGS

O-seal units can be hand-closed. Globe, angle, needle, check, and relief valves. For welded, brazed or threaded systems. Soft nylon disc and removable, flat, monel valve seat. Valve closes completely even when there are foreign particles on seat. Resilient nylon disc is swaged into valve guide. Positive seating with pressure above or below seat. Metal button or heat sink below disc. Can be installed or removed without springing line. O-ring recessed in face of each tailpiece secures positive seal between static metal surfaces. The higher the pressure, the tighter the seal. Vibration, line surges, or temperature changes do not offset seal.

**Specifications:** For 6000-psi liquids or gases. For temperatures from −20 to 275 F. In standard piping sizes from ¼" to 2".



**Designation:** O-Seal System—*Combination Pump Valve Co., Philadelphia.*

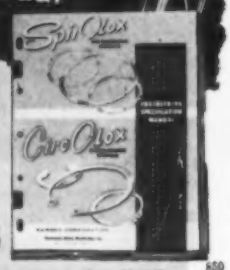
Circle **317** on Time-Saver Card

### GEAR PUMPS

Pressure balanced system pressure imposed behind areas of wear plate equalizes effect of pressures on

Continued on page 136

this **free** engineering specification manual shows you how...

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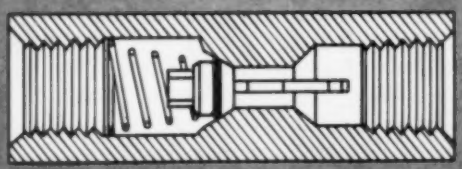
Circle **124** on Time-Saver Card

**Lowest Priced Highest Quality**

**Soft Seat CHECK VALVES**



**...with positive sealing**

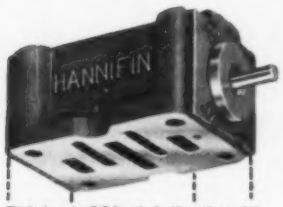
- Low Pressure Drop — large flow passages and straight-line flow assure minimum pressure drop.
- Excellent Flow Characteristics — poppet is guided to assure positive sealing and prevent cocking. In-line flow creates a self-cleaning action.
- Long Service Life — positive poppet stop prevents damage to long-life stainless spring.
- Rugged — one piece leakproof body.
- Safe—not affected by foreign particles.

- For oil, gas vacuum, water and other fluids.
- Pressures: Brass to 2,000 psi Steel to 5,000 psi Stainless Steel to 5,000 psi
- Sizes: ⅛" thru 1" dry seal threads AND-10050-4 thru AND-10050-16 Ports

*Write for detailed literature.*

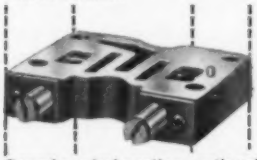
THE MANATROL Corp.
2372 W. 7th St. • Cleveland 13, O. • CH 1-0575

Circle **91** on Time-Saver Card



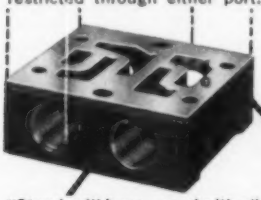

This basic CC body is the "heart" of every CC valve. Its one moving part is the "spool poppet", a Hannifin exclusive that seals bubble tight at either end of its short stroke. Note the ample air passages—all ¼" IPS or larger. This is single-actuator, spring return version.

This is the same body with double-end "spool poppet"—used when two actuators are required.

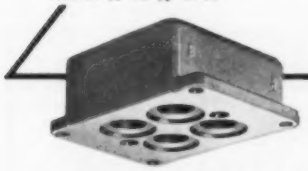


Speed control section, optional—designed to restrict exhaust flow, only, through either or both cylinder ports. Flow to the cylinder remains completely unrestricted through either port.

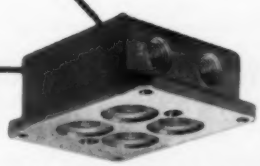
For foot-operated valves, the actuator is also the base, and this rear-ported adapter is used. Available tapped either ¼" or ⅜" IPS.



"Standard" base—used with all but foot-operated models. Every CC base is available tapped either ¼" or ⅜" IPS.



Optional base for "O" ring gasket mounting. Supplied complete with 4 O-rings.



"Universal" base, tapped from beneath and from both sides. Four pipe plugs supplied. Can also be used with O-rings.

# THESE QUICK-RESPONSE 4-WAY VALVES MOVE AIR DOWN THE LINE—FAST!

Hannifin CC valve design is the reason. Short, positive strokes of the "spool poppet" open up instant and ample passages for air.

## Actuation? Any way you want it!

One basic body with a wide selection of operating heads and bases—all with or without our new speed control section—give you over 3,000 choices. We can help you make the right choice . . . through our field engineering service. Call your nearest Parker-Hannifin office or write us direct for full information.

## SINGLE ACTUATORS
(Spring Return)

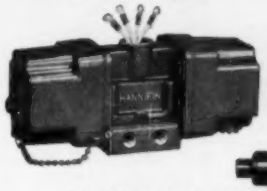
## FIVE HAND VALVES

## TWO FOOT VALVES

## TYPICAL COMBINATIONS
(Hundreds Available)

FOOT-OPERATED, LOCKING; PRESSURE OVER-RIDE —used on foundry machinery

CAM-OPERATED; PRESSURE-RETURN —used on automatic wash tanks



DOUBLE SOLENOID —used everywhere

PRESSURE-OPERATED; PRESSURE-RETURN —used everywhere

PARKER HANNIFIN CORPORATION

**HANNIFIN COMPANY**
A DIVISION
545 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

3138 PH.

Circle **65** on Time-Saver Card

Circle **81** on Time-Saver Card

NEW MAGNETIC CLEANER for HYDRAULIC POWER UNITS the Kebby Tank-Trapper

★ Powerful Alnico V Magnets
★ Highest Active Area
★ Engineered for Power Concentration
★ Easy to Apply
★ Low Priced . . . Quick Delivery
★ No Moving Parts . . . No Maintenance

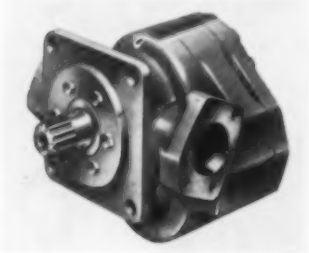
MEETS NEW J.I.C. HYDRAULIC STANDARDS

The Kebby Tank-Trapper is specifically designed to complete the protection of hydraulic systems against damage by iron particles worn off moving parts of various components. It picks up material missed by the filter and prevents premature filter loading. Expensive shut downs and service calls are drastically reduced. Write for Bulletin 1-500-59.

THE KEBBY COMPANY
2320 Custer Avenue Rockford, Illinois
Designers and Manufacturers of Magnetic Devices, Kebby Mite and Filtray Coolant Cleaners

# NEW PRODUCTS

plate's gear side. This minimizes oil slippage and frictional losses. Improved roller bearings, high-pressure seal, and method of housing assembly.



**Specifications:** Capacities are 72, 92, and 112 gpm at 1200 rpm, 0 psi. For speeds to 2000 rpm, pressures to 1500 psi.

**Designation:** 3600A Series—*Hydreco Div., New York Air Brake Co., Kalamazoo.*

Circle **318** on Time-Saver Card

### BALL VALVES

Made of unplasticised polyvinyl chloride. Non-toxic, non-flammable, and almost non-aging. Can be heat welded or solvent-bonded into line. Teflon seats. Full flow when open. Can be cleaned, and have seats and packings replaced without removal from line. Positive stops indicate full-open and full-closed. Coupling-like assembly permits each half of valve to be fitted to pipe ends, before reassembly.

**Specifications:** Compound has tensile strength of 8500 psi. extremely light weight. For temperatures to 140 F. Rated at 125 psi. ½", ¾", and 1" NPT, female.—*Hoke, Inc., Cresskill, N. J.*

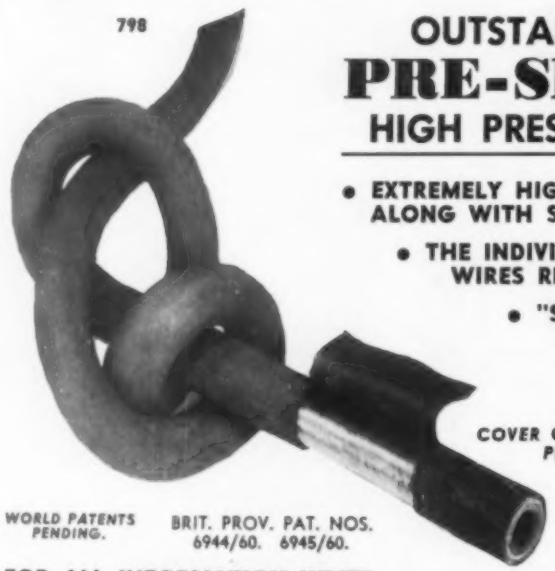
Circle **319** on Time-Saver Card

### HYDRAULIC FILTERS

Filter body shapes simplify intake piping. Tell-Tale filter can often be installed on pumping unit without elbows. Pump's pressure-drop capacity need not be used just to lift fluid to pump. Varying resistance of pressure-drop control spring limits pressure drop in intake line. This eliminates cavitation—by-pass opens before suction can become

Continued on page 138

798



OUTSTANDING SUCCESS WITH THE
PRE-SPIROFLEX METHOD OF
HIGH PRESSURE HOSE MANUFACTURE

- EXTREMELY HIGH PRESSURES ARE OBTAINED ALONG WITH SUPER-FLEXIBILITY.
- THE INDIVIDUALLY CONTROLLED HIGH TENSILE WIRES REMAIN INERT AFTER WRAPPING.
- "STAY-PUT" COVERS ALLOW EASY ASSEMBLY OF FITTINGS.
- LONGER HOSE LIFE DUE TO LESS COVER FRICTION.

COVER CUT BACK TO SHOW PRECISE WRAP.

WORLD PATENTS PENDING. BRIT. PROV. PAT. NOS. 6944/60. 6945/60.

FOR ALL INFORMATION WRITE:
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ELECTRIC CABLE, FLEXIBLE TUBE & PIPE, BRAIDING AND WIRE ROPE MACHINERY OF EVERY DESCRIPTION.
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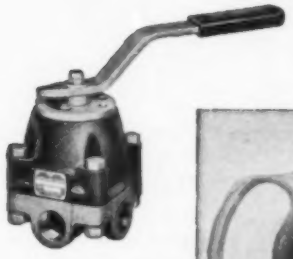
PRECI-MATIC CORP., 60 E. 42ND. ST., NEW YORK 17, N. Y. GRAMS: "BRAIDERS BOLTON"

## *For High Pressure (to 10,000 P.S.I.)*

# *MANUAL WATER VALVES*

### *that last*

### *Specify "SHEAR-SEAL" design*



4-Way, Manipulator, Dual pressure and Shut-off Valves from ¼ to 1½" N.P.T.

Note the mirrorlike sealing surfaces on this Dual Pressure Valve rotor after 4 years of service.

On extrusion presses, die casting machines, rubber and plastic molding presses and on blowout preventers, they have performed without maintenance longer than any other type of valve.

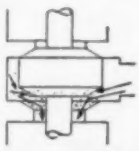
**This LONG, MAINTENANCE-FREE SERVICE** is possible because the metal-to-metal sealing surfaces are self-aligning and actually improve with use through continued lapping action. Sealing qualities do not diminish because a spring compensates for the wear.

**DIRT CANNOT SCORE SEALS** because flow is through "Shear-Seals," sealing surfaces remain in constant intimate contact.

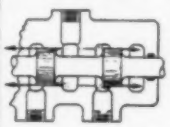
**COMPLETE CONTROL OF YOUR CIRCUIT** because "Shear-Seal" design is excellent for throttling. It permits opening to any desired degree of flow with smooth action and without fighting fluid pressure.

The "Shear-Seal" action eliminates line surges and the round tubular flow passages provide more flow and velocity capacity (up to 60 ft. per sec.) because they are unobstructed by spools or poppets.

*This is why we don't use* **SPOOL OR POPPET DESIGN**



*Poppets score*



*Spools leak*

Write for Catalog V-59-60

CONTROL VALVE DIVISION

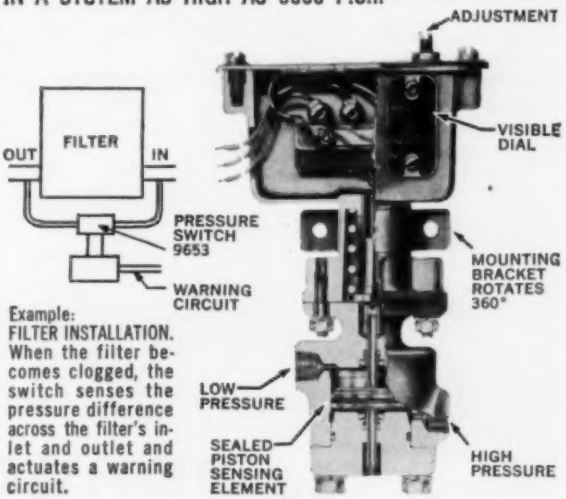
**Barksdale valves**

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **15** on Time-Saver Card

# NEW PRESSURE DIFFERENCE SWITCH

SENSES A LOW DIFFERENCE OF 10 P.S.I. EVEN IN A SYSTEM AS HIGH AS 5000 P.S.I.




Example: FILTER INSTALLATION. When the filter becomes clogged, the switch senses the pressure difference across the filter's inlet and outlet and actuates a warning circuit.

The new Model 9653 is constructed to sense a difference from 5 P.S.I. to 140 P.S.I. between two pressures. A sealed piston sensing element actuates an electric circuit on increasing or decreasing of a predetermined pressure difference. It is applicable to oil systems ranging from 50 P.S.I. to 6000 P.S.I. working pressure. A high proof pressure rating of 9000 P.S.I. is your protection against damage from surges and shock loads. Field setting is simplified by means of an external adjustment screw and visible dial.

| WE BUILD IN | WE DON'T USE |
|---|---|
| **RUGGEDNESS**<br>Can take surges—<br>(High proof pressures)<br>Continuous operation—<br>(Millions of cycles)<br>No sticking—<br>(in dirty fluid) | <br>**LINKAGES & BEARINGS**<br>Which wear quickly—(cause settings to drift and switch to fail). |
| **LABOR & MATERIAL SAVINGS**<br>No return drain piping—<br>(Sealed piston)<br>Mounts where convenient<br>(Operates in any position,<br>Not sensitive to vibration) | <br>**UNSEALED PISTONS**<br>Which add to your installation cost (return piping).<br>Are critical to dirt—(pistons get stuck). |

Ask for new pressure switch handbook and catalog '59-'60

PRESSURE SWITCH DIVISION

**Barksdale valves**

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **16** on Time-Saver Card

## NEW PRODUCTS

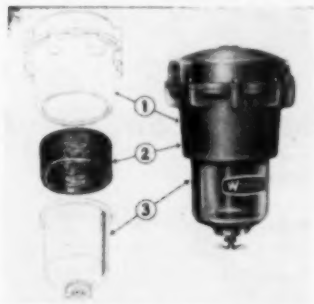
excessive. Shapes include bottom inlets, side inlets, and side outlets. All have sliding cartridge and external dirt indicator. All can have electric limit switch for remote indication of filter's degree of clogging.—*Rosaen Co., Hazel Park, Mich.*

Circle **320** on Time-Saver Card

### AIR FILTER

Extra casting between cover and bowl houses cartridge. This makes it possible to use a larger cartridge. There is less pressure drop. More air can flow through. Bowl is for storage only. It holds a half-pint of contaminants before draining is necessary. Cartridge is rigid, impregnated felt. It can be cleaned in solvent, and reused. Bowls of metal or transparent plastic. Gaskets are Buna N rubber.

**Specifications:** Filtering area of cartridge in ½" PT size is 17.5 sq in. 5-micron filtration. For pressures to 250 psi, temperatures to 250 F. Pipe threads from ¼" to 3". Flow 16 to 3100 cfm at 100 psi.

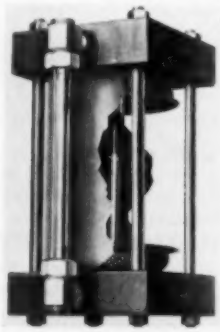



**Designation:** Pure-Flo—*Wilkerson Corp., Englewood, Colorado.*

Circle **321** on Time-Saver Card

### AIR-OIL TANK

For booster-equipped cylinders or machines. Baffle eliminates fog at air exhaust. Bell-shaped baffle of



steel mesh permits fluid to enter or leave tank quickly without turbulence. Tank can be mounted on booster or remotely.

**Designation:** Power-Flo Baffle—*S-P Mfg. Corp., Cleveland*

Circle **322** on Time-Saver Card

### NEEDLE VALVE

Stem can't blow out or back out under pressure. Inside neck threads

are integral part of valve body. Stem is made of stainless steel. Rolled stem threads. Stem protrudes through wrench-tightened

Continued on page 140


ON THE JOB...

with CROSS HYDRAULIC CYLINDERS

Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Cross Engineering Department, today!

- RUGGED
- DEPENDABLE
- ECONOMICAL

CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION

Try CROSS CYLINDERS in your operation... low cost, dependable, and trouble free.

Lowest-Priced Engineered Quality Cylinders Available..

trade mark of Quality in Hydraulic Cylinders...

CROSS MANUFACTURING CO.
LEWIS, KANSAS – PHONE EA 4-5525

WRITE • WIRE • PHONE...TODAY!!

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# new ROTORAM® VALVES

**WITH EXCLUSIVE ROTATING STEM**

for MILLIONS of TROUBLE-FREE ACTUATIONS

Treadle Valve

Knob Valve

- Low silhouette mounting
- 2024 T4 aluminum bar stock
- Rust-resistant
- Full flow air passages
- Piped exhaust ports
- Interchangeable parts
- Anodized finish

Cam Valve

Finger Valve

Pedal Valve

Hand Ball Valve

Rotoram Valves are available in 3 and 4-way models for ⅛", ¼", ⅜" and ½" pipe sizes. Special Block "V" Packing permits free ram movement, insures long valve life. Port entry from either left or right side. Ask your AIR-MITE Distributor, or write for complete details and illustrated catalog.

**AIR-MITE DEVICES, INC.**

4401 W. Kinzie St., Chicago 24, Ill.

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**Accurate Control of Fluid Motion**

## THE IDEAL SMALL CAPACITY ROTARY OIL PUMP

**THOMAS SAVERY PUMPS, LTD.,**
**BRACEBRIDGE ST., BIRMINGHAM 6, ENGLAND**

**Savery HYDRAULIC PUMPS**

American and Canadian Agents:—
DAVIES BROTHERS, Gladstone, New Jersey, U.S.A. PEapack 8-1290

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# 3 CLASSES

## OF PRESSURE GAUGES meet all service demands

**1.**

◀ ASHCROFT DURAGAUGES. The finest pressure gauges built—highest in sustained accuracy and durability. Ideal for the toughest services. Save many times their initial cost in replacements and repairs.

**2.**

ASHCROFT QUALITY ▶ GAUGES. Tops in general-purpose gauges — second only to the Duragauge. Available for pressure, vacuum or compound services in low, medium, and high ranges.

**3.**

◀ ASHCROFT STEEL CASE GAUGES. None better for small equipment like portable compressors, pumps, and for less important pressure lines. Pressure, vacuum, and compound ranges available.

Ashcroft dial sizes range from 2″ through 24″ . . . pressures from 30″ vacuum or a few ounces up to 100,000 psi . . . materials to suit the application. Among the many Ashcroft Gauges are Maxisafe®, pneumatic receiver, recording, chemical, special purpose types, and various gauge testers. Invest wisely. Make your selection precisely for the job. Chose from the complete line of Ashcroft Gauges. Write for Catalog 300 B.

***ASHCROFT PRESSURE GAUGES***

*A product of*

**MANNING, MAXWELL & MOORE, INC.**

*Gauge and Instrument Division • Stratford, Connecticut*
*In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ont.*

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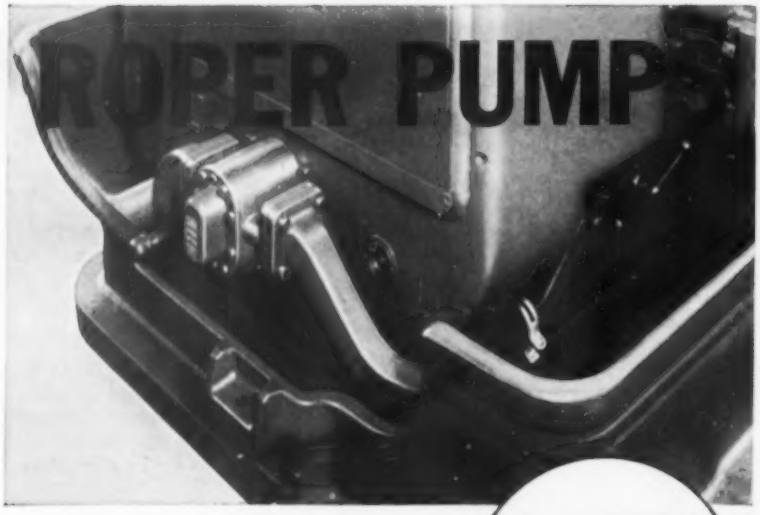

SERIES K

# adapted to the demands of a wide range of jobs

**¾-50 GPM • PRESSURES TO 150 PSI • SPEEDS TO 1740 RPM**

Typical of the great adaptability of the compact Roper Series K rotary pump is its service as a coolant pump in supplying soluble and cutting oils to this automatic screw machine. The requirement for instant priming in this machine requires a positive displacement pump. The rugged Series K meets the specifications of many original equipment manufacturers who require dependable, quiet, efficient transfer of clean liquids in hydraulic service, fuel supply duty for large oil burners, or diesel fuel oil transfer. Special fittings for transfer of corrosive liquids and special mountings to meet installation requirements can be supplied. Series K models can be direct connected, chain-, belt-, or gear-driven. Precision construction and thorough individual pre-testing insure its durability of performance. Specify Roper for rugged dependability.

## Features behind Series K versatility

● Simplified design . . . only two moving parts ● Smooth flow . . . quiet operation ● Interchangeable mounting brackets . . . easy to install ● Precision-built . . . requires little operating power ● Self-priming . . . high suction lift . . . correct hydraulic principle ● Built-in relief valve . . . adjustable or pre-set.

*For information about your specific pump needs, contact your nearest Roper dealer*

**Send for "How to Solve Pumping Problems" booklet**

**ROPER HYDRAULICS, INC.**

**Dependable pumps since 1857**

COMMERCE, GEORGIA

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## NEW PRODUCTS

nut which can't come loose. Teflon back-up ring prevents dirt or contamination from entering valve. O-ring seals stem.

**Specifications:** Rated at 10,000 psi.

**Designation:** Series 5000—*Dragon Engineering Co., Norwalk, Calif.*

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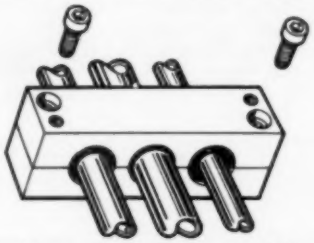
### TUBE SUPPORT BRACKET

Clamp halves can be bolted to machines or to each other. Rubber

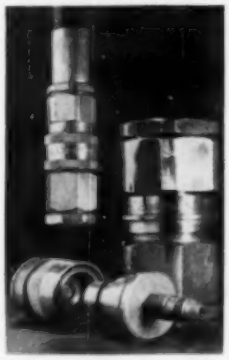


bushings which fit around tubes have different ID, same OD. Brackets can support tubes of different OD. Fastener openings permit clamps to be stacked.—*Thunderbird Industrial Equipment Co., Livonia, Mich.*

Circle **324** on Time-Saver Card

### QUICK CONNECTS

Electroless nickel plating provides corrosion-resistance. Plating is free of voids. No void between coating and base material. Virtually zero porosity. Resists abrasion. Plating process doesn't affect tensile strength or ductility of steel.



**Specifications:** Coating adhesion pressures are 30,000 to 60,000 psi. *Snap-Tite, Inc., Union City, Pa.*

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**Continued on page 142**

Circle **85** on Time-Saver Card

# KUNKLE GAUGES

FOR PROCESS & POWER INSTRUMENTATION

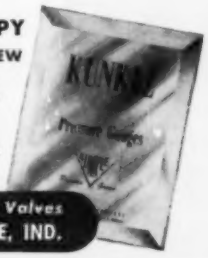
## KUNKLE GAUGES

Complete, broad range line makes gauge application-specification easy with assured results backed by 50 years of gauge manufacturing experience.

Ranges from 15 p.s.i., or 30" of vacuum, to 20,000 p.s.i.

Bourdon tubes of bronze, drawn or bored s/s, and other alloys

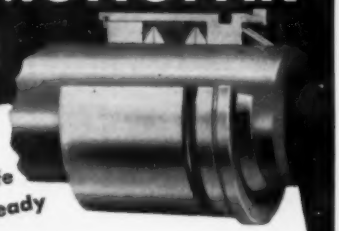
**YOUR COPY** SHOWING NEW GAUGES AND SPEC. DATA NOW AVAILABLE WRITE:



*By the makers of dependable Kunkle Valves*

KUNKLE VALVE CO. · FT. WAYNE, IND.

# REDUCE MACHINING EXPENSE with the MONOPAK® CARTRIDGE



Special features:

- Longer service life
- No machining, ready to use
- Tamper-proof, needs no adjusting
- Easily installed or replaced
- Includes "Seal Guard®" rod wiper
- Cuts machine down-time
- Low friction down-time
- Anti-backlash rings

A complete packing unit for hydraulic or pneumatic rods or cylinders, this cartridge combines all necessary packings, bearings, and rod wipers into one shock and burst proof unit.

Write for complete information

**HYDRAULIC ACCESSORIES CO.**
24301 Hoover Road
Warren, Mich.

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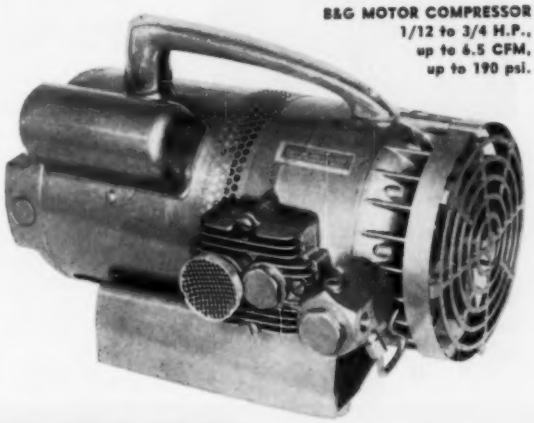
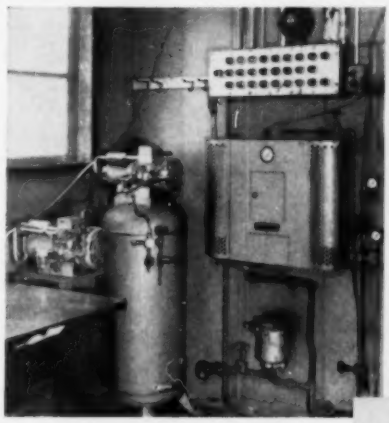
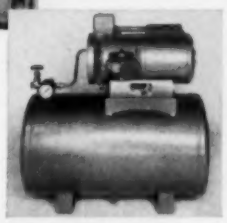
**B&G MOTOR COMPRESSOR**
1/12 to 3/4 H.P.,
up to 6.5 CFM,
up to 190 psi.



# ON-THE-SPOT *Oil-less* COMPRESSED AIR FOR INSTRUMENT CONTROL



**30 gal. A.S.M.E. Air Tank Outfits** 75 and 175 lb. units.



**10 gal. Air Tank Outfits.** 35, 75, 135 lbs. units mounted on non-code tank. 75 and 175 lb. units available with A.S.M.E. Code tanks.

For instrument control with compressed air, patented B&G Oil-less Compressors offer outstanding, exclusive advantages.

They deliver air *completely oil-free!* Carbon-graphite piston rings and skirts need no lubrication; bearings are grease-packed and sealed for life. Numerous design and construction features assure dependable delivery of cleaner, cooler, drier air and smoother operation.

B&G Oil-less Compressors can be located at the site of the control, eliminating long pipe lines which may contaminate the air with dirt and condensation.

58 Models to choose from — tank mounted, portable, motor and gas engine driven.

For complete information on B&G Oil-less Compressors and Vacuum Pumps, send for Catalog GO-1156.

*Oil-less*
**AIR COMPRESSORS**
**BELL & GOSSETT COMPANY**
Dept. GK-66, Morton Grove, Illinois

Circle **18** on Time-Saver Card

## NEW PRODUCTS

### THREADED UNION FOR BRAZED TUBING SYSTEMS

Positioned brazing ring inside socket provides semi-permanent, brazed tubing joint. For high pressure and other critical service. Both parts have socket for brazing to tube. One part has SAE hydraulic 37-deg flare cone. Swivel nut of the other part mates with straight-thread cone. Provides metal-to-

metal seating. In steel and stainless steel.

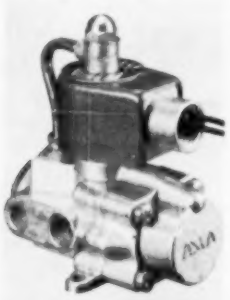
**Specifications:** For tubing from ¼" to 2" OD.

**Designation:** Braze-lok—*Parker Fittings & Hose Div., Parker-Hannifin Corp., Cleveland.*

Circle **326** on Time-Saver Card

### 4-WAY SOLENOID VALVE

2-position valve has single solenoid. Forged brass body. Poppet-type seats and discs. Main valve discs are power-driven in both directions. No return springs. Packless. Combination of metal-to-metal and resilient seating. Tight seating on



air and liquids without grinding or adjustments. Mounts in any position. Solenoid enclosures to suit any application.

**Specifications:** ⅛" orifices. ¼" or ⅜" pipe connections. For air, water or oil at pressures to 250 psi, temperatures to 212 F. All standard voltages.
*Automatic Switch Co., Florham Park, N. J.*

Circle **327** on Time-Saver Card

### 1-MICRON FILTER

Fluids are forced through multiple layers of diatomaceous earth powder and fine-mesh monel screen.

**Specifications:** Filters to 300 gal/hr. Height is 12"; diameter, 9". Weighs less than 10 lb.

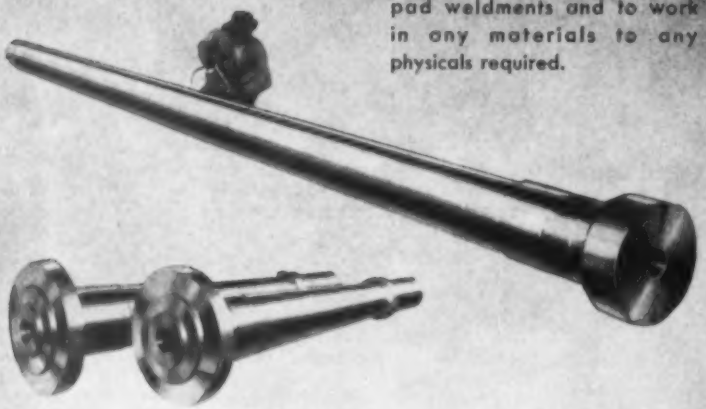
**Designation:** Model C-4510 Bell Filter—*Wire Cloth Products, Inc., Bellwood, Illinois.*

Circle **328** on Time-Saver Card

**Continued on page 144**


PRECISION
BORED and HONED PARTS
by
American

If your deep bored and honed part is up to 16" I.D. and up to 40 ft. long, we are equipped to meet your exacting specifications. We have the tooling and the experienced skills to produce hollow parts to any internal or external finish desired. We are equipped to supply flanged or pad weldments and to work in any materials to any physicals required.



*American's special boring and honing service is described in a 20 page brochure. Write for a copy.*

AMERICAN HOLLOW BORING CO.

*You can depend on American as a reliable source for precision bored and honed parts for your most exacting applications.*

1060 West 20th Street • ERIE, PENNA.

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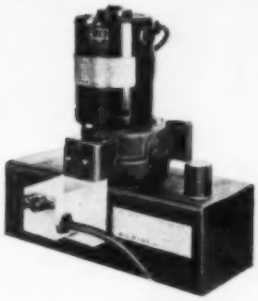
Circle **107** on Time-Saver Card

## A complete OIL-DYNE hydraulic unit could fit on this page — with room to spare!



If you still believe that hydraulic units must be big and bulky, you just haven't seen Oil-Dyne's miniature power package! And if you think the motor or pump must run constantly, you haven't heard that an Oil-Dyne motor and pump run ONLY while the cylinder piston is in motion. Perhaps, too, you didn't know that Oil-Dyne has eliminated all the complex external valving for directional control . . . and that when you shut off an Oil-Dyne reversible pump, the piston is automatically locked in position, and stays there indefinitely. Just to make sure you're aware of what's happened in hydraulics since Oil-Dyne pioneered miniaturization, you ought to write for our Catalog 21-E.

PIONEERING MINIATURIZED HYDRAULIC ACTUATION

**OIL-DYNE INC.**

2115C West Marquette Road • Chicago 36, Ill.

PUMPS • CYLINDERS • VALVES
PRESSURE SWITCHES • ACCESSORIES

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## Piggy Back Air Control

- Saves Space • Improves Control
- Simplified Installation

This compact "3 in 1" combination Air Regulator, Filter, and Lubricator requires a minimum of space and installation work . . . and delivers a maximum of protection against damage to costly air tools.

The balanced piston Regulator permits instant response to load changes . . . automatically bleeds off . . . and serves as a shut-off valve. The cyclone action of the Filter and its throwaway type filter element remove water, oil, and dirt. The Lubricator is adjustable, to automatically meter a fine oil mist in direct proportion to the volume of air being used.

Available in stock in ¼" through ¾" NPT. For a complete line of air controls and quick disconnects write for Bulletin 80.

"WHERE *Good Connections* COUNT"®

**PERFECTING SERVICE CO.**

332 Atando Avenue Charlotte, North Carolina

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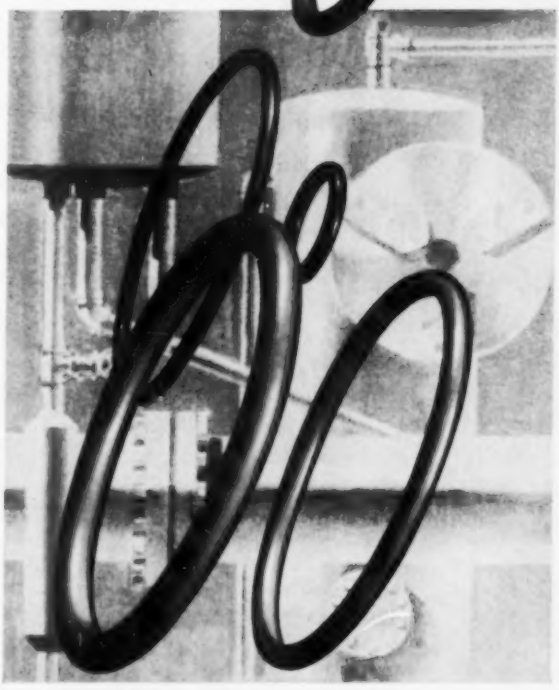
## NOW...*for the first time, Stillman aircraft quality and know-how are available in* "O" INDUSTRIAL RINGS



Through Stillman Technology and volume production, Stillman high-quality O-Rings are available at extremely low cost. The same quality and reliability that are engineered into O-Rings for the aircraft and missile industries are also featured in the new Stillman Industrial O-Rings. These all-purpose seals are designed for use in all phases of industrial sealing, and are uniformly high in important features of chemical resistance, low swell, long life, and sealing dependability. Stillman O-Rings are stocked in a complete range of sizes for rapid delivery.

Write for the all-new Stillman Industrial O-Ring brochure, free on request.

NOTE: *Major distributorships still available in some major cities.*

**STILLMAN RUBBER COMPANY**

Culver City, Calif./Cleveland, Ohio/Englewood, N.J.

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# Keep YOUR HYDRAULIC SYSTEM Clean with HILCO HYDRAULIC OIL FILTERS

- No More Varnish and Sludge Deposits
- No More Flushing and Manual Cleaning
- No More Frequent Oil Changes
- No More Accumulation of Dirt

**Filter life up to a year eliminates usual frequent draining, refilling of systems.**

HILCO Hyflow Oil Filters trap dirt, acids, rust, sludge, gums, resins . . . all solid contaminants, and keeps your hydraulic system clean and in top running condition at all times. To you, this means longer oil life, reduced wear and abrasion . . . hence, less down time and lower maintenance costs giving you continuous equipment operation with increased production. Hydraulic unit sensitivity depends upon a clean system. HILCO Hyflow filters remove solids as soon as they enter the system and retain much of the moisture which enters the oil from the atmosphere and from condensation. Obtain the full capacity and economy of your equipment by keeping it in top running condition with HILCO. Hydraulic Oil Filters come in stationary or portable models. They can be hooked into hydraulic systems without interrupting equipment operation.

HILCO OIL RECLAIMER

For complete oil reclaiming. Removes solids, acids and volatile impurities; moisture, solvents, gasses, etc., from hydraulic fluids by heat-vacuum process.

**• SEE FOR YOURSELF HOW HILCO keeps your Hydraulic System Clean . .**

WRITE TODAY FOR THIS *Free* BOOKLET

Recommendations at no Obligation

THE HILLIARD *Corporation*

148 W. FOURTH ST. • ELMIRA, NEW YORK

IN CANADA UPTON-BRADEEN-JAMES, LTD. 890 YONGE ST. TORONTO • 8760 VERVILLE ST., MONTREAL

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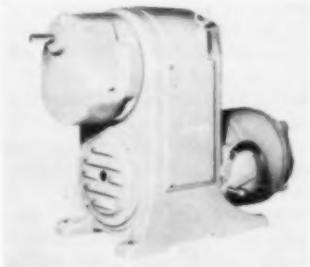
# NEW PRODUCTS

### *VARIABLE SPEED DRIVE*

Standard, high-speed electric motor and variable-speed transmission. New gear increaser. Metered lubri-



cation. No external gear boxes, belts, or pulleys.

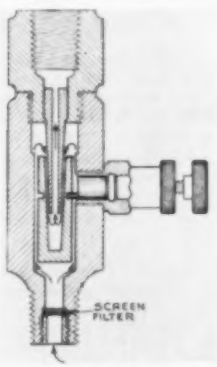
**Specifications:** For sustained operations at speeds from 2500 to 25,000 rpm. Less than 2' high. Available with motors to 5 hp.

**Designation:** VEU-GHY—*U. S. Electrical Motors, Inc., Los Angeles.*

Circle **329** on Time-Saver Card

### *GAGE PROTECTOR*

Protects gages from pulsation, regardless of viscosity or surface tension or pressure medium, and




amplitude or frequency of pulsation. Pressure orifice can be made larger for high viscosity, or smaller if pressure is small and frequency of pulsation great. Operates vertically or horizontally. Lock nut holds adjustment. Screen filter at inlet.

**Designation:** Throttler—*Marshalltown Mfg. Co., Marshalltown, Iowa*

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# Standard *For* Industry

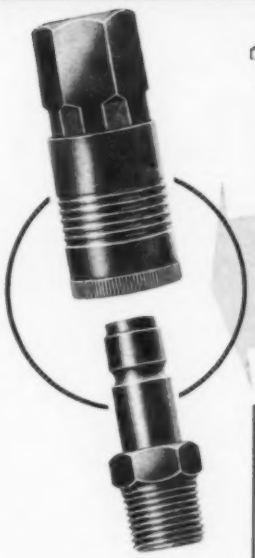
## CENTURY Liquid Level SIGHT GAGES

- **Easiest Possible Installation** on any wall thickness
- Large Face for Better Visibility—7″ Overall
- Can be used with non-inflammable oil
- Leak-Proof — No Dripping
- For Better Service at Lower Costs, Start Using Century Gages Today
- Available Immediately — from STOCK

Send for new catalog containing dimensional information on hydraulic reservoirs and complete line of power unit accessories.

**CENTURY HYDRAULICS**
Division of CENTURY-DETROIT
6101 Concord Ave. • Detroit 11, Mich.
Telephone: WAlnut 3-8088

# TRU-FLATE



## TRU-FLATE.
QUICK DETACHABLE
## couplers AND nipples

Quick couplers for air, steam, oil, gas, water, oxygen, etc. A broad range available of types and sizes....

*FREE.... Write for free copy of Tru-Flate's illustrated Industrial Catalog No. 4.*

**TRU-FLATE, INC.**
888 92nd AVE OAKLAND 3 CALIF

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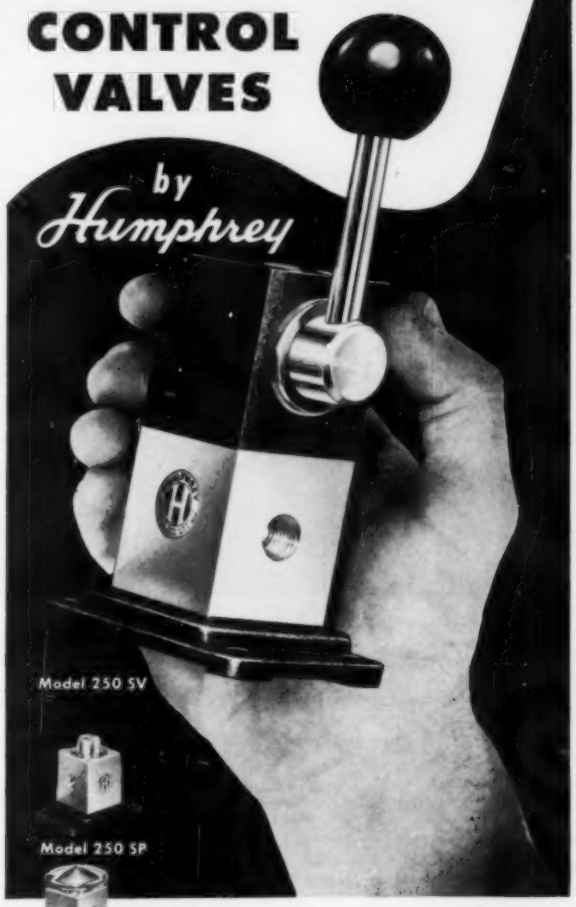
# NEW! *Design idea for... Machine Tool Builders*

## PRECISION MADE . . . HEAVY DUTY CONTROL VALVES *by Humphrey*



Model 250 SPL

Model 250 SHO

Model 250 SB

Model 250 ST

Model 250 SC

These new Humphrey valves are a designer's dream. Distinguished in appearance . . . a quality product. Compact and rugged, ideal for applications requiring heavy duty durability. Precision made for smooth, easy operation.

Aluminum bodies and steel levers are machined from bar stock. Bases and actuators are tough Tensiloy castings. All are ¼″ size, with built-in quick exhaust and 80.04 cfm air capacity at 100 psi.

***Get new literature now. No cost or obligation.***

*Humphrey Products* DIV.
GENERAL GAS LIGHT COMPANY
Kalamazoo, Michigan

**FREE!** 16-page catalog, shows engineering drawings

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# ANNOUNCING

## SHATTER-GUARD

**A safety feature now standard on M/P Filters and Lubricators**

- Eliminates the "burst" hazard
- Contains all fragments and parts including drain cock when burst occurs
- Resists damage by impact
- Retains visibility advantage

Any transparent filter or lubricator bowl used in a compressed air system may be weakened by *impact, heat* or *chemical attack*. The eventual burst frequently scatters parts and fragments violently.

To eliminate this hazard M/P now supplies the *Shatter-Guard* as a standard part of every *Visi-Bowl* unit. *Only M/P transparent bowls are as safe as metal bowls.*

A brochure outlining bowl-breakage causes and describing M/P Field Conversion Kits is available. Consult your local representative or M/P for complete information.

**NEW AIR CYLINDER LUBRICATOR**

For application in the M/P *Down-Stream Circuit* — a new M/P concept which assures reliable lubrication of even the smallest cylinders.

**HYDRO-JECTOR**

The M/P automatic drain valve that can be installed in the bottom drain port of any compressed air filter, drain leg or surge tank.

**MASTER PNEUMATIC, INC.**

20430 SHERWOOD • DETROIT 34, MICHIGAN • Phone: TWinbrook 3-7070

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# USEFUL LITERATURE

Continued from page 58

### MOISTURE CONDENSER

Uses no water. Nothing to recharge. Direct-expansion interchanger cools compressed air to a low dew-point temperature. This removes the moisture. Automatic control of compressor unit provides for constant interchanger temperature. Automatic ejection of condensate is optional. Measures 12" x 10" x 26" high. Weighs 74 lb. For 7 cfm, 150 psi. Uses 115 vac. Power consumption is 2.2 amp. Adjustable temperature controller factory set for interchanger temperature of 30 F. *Zeks Industries, Haverford, Pa.*

Circle **409** on Time-Saver Card

### 2-WAY AIR VALVES

Lever-operated. Heavily spring-loaded poppets. Buna-N discs. Raised seats have sharp, single-line contact with discs. ⅜"-dia stems don't bend, to cause air leak between packing and stem. All internal parts can be removed without removing valve from line. Hold-open and self-closing types. Aluminum or bronze bodies. Bulletin F-44-RE. *OPW-Jordan, Cincinnati.*

Circle **410** on Time-Saver Card

### BACK-UP RINGS

Molded in one continuous circle. Can be stretched into place. No break-apart cuts or other means of fabrication which can allow O-ring extrusion, pinching, or biting. No chance of misalignment, which might cause cutting or tearing of O-rings. Backups tend to keep O-ring round, even under high pressure. Aid in providing adequate O-ring lubrication. Concave side can face toward or away from O-ring. By allowing a wider metal-to-metal clearance, backups help overcome difficulty of wide or out-of-tolerance bores and shafts. Backups allow for breathing of cylinder walls. Catalog 5482 has tables of sizes and dimensions, specification hints, and compound information. Graph tells when various materials extrude. *Parker Seal Co., Culver City, Calif., and Cleveland, Ohio.*

Circle **411** on Time-Saver Card

Continued on page 148

Circle **83** on Time-Saver Card


**NEW!** KEPNER **Kepsel**

*The Check Valve that cuts costs of Design and Installation 75% and more!*

- Leak Proof—At All Pressures
- Low Pressure Drop at Full Flow
- Eliminates All Threaded Connections
- Eliminates Expensive Machining

Small in size—big in capacity—simple to install—the KEPNER Kepsel Cartridge Type Check Valve is designed for positive performance. Eliminates expensive machining, finishing of fine, close tolerances, metal surfaces—dirt can't hurt it.

*Write for complete technical data*

*Patent Applied For

KEPNER PRODUCTS COMPANY
7321 West 59th Street Summit, Illinois


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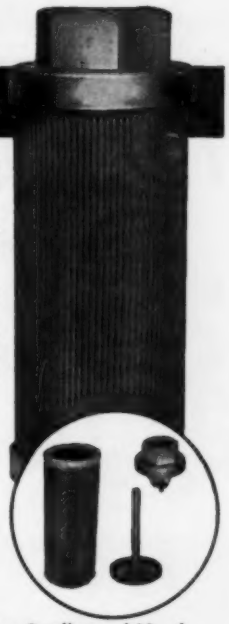
**Capital**
**HYDRAULIC FILTERS**



**STANDARD RESERVOIR TYPE** — 7 sizes . . . 5 to 50 gallon capacity and larger sizes on special order.

**MONO-BILT** — Standard, All Stainless Steel in 7 sizes . . . 5 to 50 gallon capacity and larger sizes on special order.

**MONO-BILT** — 60 Mesh Sump Type in 7 sizes . . . 5 to 125 gallon capacity.

**MONO-ECONO** — Specially Mono-Bilt with Monel Metal Insert . . . Cadmium plated top and bottom. 9 sizes . . . 5 to 150 gallon capacity.

MONEL METAL INSERTS

**Line Type HYDRAULIC FILTER**

3 sizes . . . 5 gallon, 8 gallon and 10 gallon capacity.

*Send for descriptive circulars*

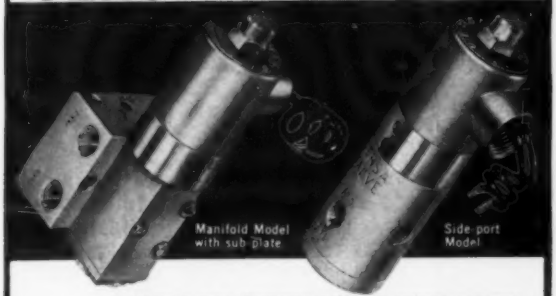
**CAPITAL ENGINEERING & MFG. CORP.**

5837 South Ashland Avenue, Chicago 36, Illinois



The Most Compact Solenoid Valve in the Fluid Power Control Field...

**VERSA SERIES "A"**




Versa's new four-way solenoid valves measure only 5½" high by 1⅝" diameter, yet have a full 3/16" diameter flow area. Completely corrosion-resistant and simple to install, Versa Series "A" solenoid valves are available in over 100 different variations. Triple pressure and functionally tested under water for guaranteed leakproofness.

**VERSA**

Write today for your free copy of Bulletin #1259

VERSA PRODUCTS COMPANY INC.
150 A COOLIDGE AVENUE
ENGLEWOOD, NEW JERSEY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**NOW** protect instruments from line pulsations and surges on refrigeration and automotive systems...

**CHEMIQUIP'S NEW RS SNUBBERS**

Designed for automotive, refrigeration or air conditioning applications, Chemiquip's newest snubber assures steady, accurate pressure readings . . . smooths out pressure impulses and fluctuations . . . protects pressure-sensitive instruments. Snubber element fabricated of Type 316 porous stainless steel membrane; unaffected by suspended oils in freon-type refrigerants . . . does not clog or plug.

Available in brass or steel in ⅛" and ¼" npt, male or female by ⅛", ¼", ⅜" and ⅜" flared and compression tubing.

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**CHEMIQUIP CO.** 36 East 10th St., New York 3 GRamercy 7-3772


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AIR He $N_2$

# COMPRESSION to 12,000 psi

...discharge capacities to 150 scfm

with

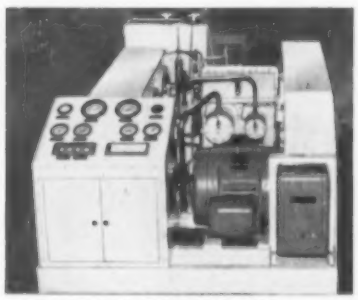
CARDAIR
CENTRAL COMPRESSION SYSTEMS

New Technical Data and Catalog. See offer below.

**Cardair Central Compression Systems (completely packaged, semi-portable)—are today handling air and a variety of gases—helium, nitrogen, argon, etc.—at pressures ranging from 4,000 to 12,000 psi with discharge capacities from 50 to 150 scfm. Even hydrogen is being safely compressed to elevated pressures.**

**Systems can be provided from stock with *guaranteed* purification of delivered gas to —100°F. dew point and less than 4 ppm oil content. Specially engineered systems to meet your particular requirements can be supplied from standard components.**

**This ability to control hard-to-handle gases, proven by years of exacting rocket and missile service, offers unlimited possibilities to industry—not only for testing and laboratory work, but also for actual production.**



**Model PB-CCS**—*One of a wide selection of systems* 4-stage air-cooled Compression System—Pressure Range: 6,000—12,000 psig—Induction: 65 to 135 psig—Capacity: 75 scfm $N_2$ and Air; 70 scfm He—Guaranteed Gas Purity: —100°F. Dew Point, less than 4 ppm oil content.

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Dept. 16, 807 N. Michigan Ave., Chicago 1, Ill.
WESTERN STATES DISTRIBUTOR:
General Air Equipment
824 Hollywood Way, Burbank, Cal.

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# USEFUL LITERATURE

### NONFERROUS CENTRIFUGAL CASTINGS

Chart covers tin bronzes, aluminum bronzes, manganese bronzes, brass, silicon bronzes, special alloys, Monel Metals, and Ni-Vee Bronze. Compares federal, military, SAE, and ASTM specifications. Fold-out Bulletin 157 shows chemical analyses and minimum physical properties. Describes components and assemblies produced by centrifugal method. *Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.*

Circle **412** on Time-Saver Card

### HEAT TRANSFER EQUIPMENT

Complete product resume includes information on radiators, heat exchangers, and air coolers. Installation photos. Catalog 160. 32 pp. *Young Radiator Co., Racine, Wisc.*

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### RULON PARTS

Rulon-A is a composition of Teflon and other inert ingredients. Requires no lubrication. Performs at temperatures from —350 to 500 F. Has greater wear resistance than Teflon, lower deformation under load, greater stiffness, and higher compressive strength. Parts include bearings, thrust washers, cup packings, shaft seals, valve seats, gaskets, wear strips, piston rings, O-rings, and insulators. Standard forms available include extruded rod, tubing, sleeving, skived tape, and shapes, molded rods, tubes, and sheets. Other Teflon compounds available. Table compares properties of Rulon-A with those of Teflon. Photos and product specifications. *Dixon Corp., Bristol, R. I.*

Circle **414** on Time-Saver Card

### RELIEF VALVES

Catalog FE-138 shows drawings, specifications, photos, and uses of 12 types of relief valves. Has capacity formulas and tables. 24 pp. *Farris Engineering Corp., Palisades Park, N. J.*

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# Portable Hydraulic Power Pumps

## 10,000 psi intermittent
## 6,000 psi continuous

No. 797-E-SA

**No. 797 series**
**213 cu in. per min. at 10,000 psi**

Extra-high-speed drive at high pressure. Applies to a wide range of hydraulic systems. Compact unit . . . pump reservoir, and control valve in one housing. Simply operated, 2-position control handle with advance and return positions. Available with 4-way valve for double-acting rams. Delivers 213 cu in. of oil per min at 10,000 psi with 3 hp a-c motor . . . 106 cu in. with 2 hp motor.

No. 797-G-SA is same pump powered with 4½ hp 4-cycle, air-cooled gasoline engine.

**No. 798 series**
**28 cu in. per min.**
**. . . at 10,000 psi**

Easily carried, high-pressure pump. Has exclusive fast approach . . . high volume, low pressure . . . automatic change-over to low-volume, high-pressure drive. Develops 6,000 psi continuous pressure, 10,000 psi intermittent. Choice of integral 2-way or 4-way valve. Built-in 115 - 230 V ¾ hp a-c motor. Also available with built-in 1.7 hp gasoline engine, universal or low-voltage motor. Write for illustrated data sheets.

***ALSO A SELECTION OF HYDRAULIC HAND PUMPS AND VALVES***

**GREENLEE TOOL CO.** GREENLEE
1775 Columbia Avenue
Rockford, Illinois

Circle **126** on Time-Saver Card

### WELDED TUBING

Comparison of weights of welded steel tubing and solid bars. Table of driveshaft torque values. Tables of strength and ductility of as-welded, normalized, drawn, and mandrel drawn tubing. Carbon steel tubing from ½" to 6" OD. Wall thicknesses from .028" to .270". Technical Bulletin states advantages of welded steel tubing to replace bar stock. 4 pp. *Standard Tube Co., Detroit.*

Circle **416** on Time-Saver Card

### VALVES

Control direction and flow of vacuum, air, water, and oil. 3 and 4-way valves have two plungers. When actuator is centered, valve is neutral, and all ports are closed. Neutral position is standard with lever, button or double-solenoid valves. It can be used on roller-operated valves. Set screw in actuator adjusts neutral position. Calibrated springs in exhaust chamber provide pressure relief. Control of speed or distance of plunger depression past inlet port provides metering. Adaptor plates (⅜" or ½" ports) permit control of combinations of single or double cylinders without tees. 3-way valves can be sandwiched. Mount on manifold blocks, sub-plates, or pipes. Bulletin shows dimensional data, and flow curves. Explains operation. *Pokorny Industrial Products Corp., Cleveland.*

Circle **417** on Time-Saver Card

### PUMPS, VALVES & MOTORS

For mobile equipment and production machinery. Gear pumps for 2000 psi, 2500 to 3000 rpm. Capacities from 3.5 to 107 gpm. Balanced hydraulic forces on both sides of wear plate maintain fixed clearance. The four assembly bolts are in area of greatest internal pressure. No radial load imposed on bearings of vane pumps. There are two vanes in each slot. Vanes produce only enough thrust against cam to seal. Deliver 3 to 70 gpm.

No reverse flow through directional control valves. Check valve built into hollow valve plunger keeps oil in cylinder circuit until pressure is high enough to move load. Single or multiple-plunger units. Pilot-operated relief valves are built into valve housing. Available with several types of internal circuits. *Hydreco Div., New York Air Brake Co., Kalamazoo.*

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NEW NEW NEW NEW NEW NEW

# NOW! 1½ TONS PER SQUARE INCH CONTINUOUS RATING

**Tested at 2½ tons per square inch*

Pathon
3000 PSI
HYDRAULIC CYLINDERS

The New Pathon Series 3H Hydraulic Cylinders are not an adaptation or modification of existing models, but specially designed 3000 P.S.I. Cylinders, continuous service. The 3H Series is available in a wide range of bore sizes and standard mounting types. Like all other Pathon Cylinders, the 3H Series features:

- Single screw thread head attaching method
- Increased strength and fatigue life
- Low Stress Concentration
- Compactness

Illustrated, Model 3H 33 incorporating spherical bearing at the pin connection.

FOR ADDITIONAL INFORMATION
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FLUID OPERATED AND CONTROL EQUIPMENT

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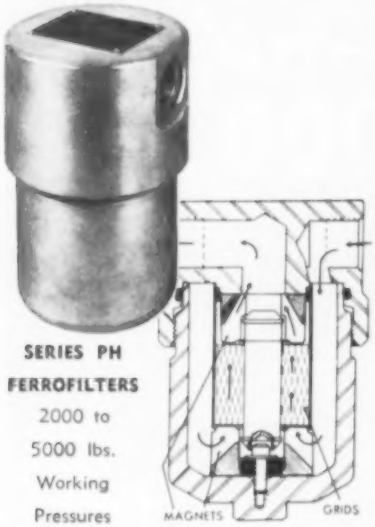
## Remove ferrous grit for maximum hydraulic performance

Wear can give you abrasive ferrous particles. Completing the vicious circle, these particles can give you more wear—and besides, cause sticking of valves, pistons and other moving parts. For certain removal of these particles, give the job to

**FERROFILTER**

**High Pressure MAGNETIC SEPARATORS**




**SERIES PH FERROFILTERS**
2000 to 5000 lbs. Working Pressures

Hydraulic fluid flows through a stack of magnetized grids which split the stream into many thin elements. Magnetic particles pass close to the grid edges, are attracted and held securely until the FERROFILTER is cleaned.

Flow capacity 12 to 40 gpm . . . Low pressure drop . . . Standard ¾" tube or pipe connections; other sizes available.

*Write for Bulletin HP*

**S. G. FRANTZ CO., Inc.**

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# POST SCRIPTS OF INDUSTRY

**News about people, manufacturers and sales organizations**

### Dynex advances Hare

Dynex, Inc., Pewaukee, Wisc., has promoted Richard C. Hare to chief engineer-mobile products. He will head the mobile laboratory, mobile project engineering, and mobile drafting and services. Hare has been advanced engineering manager with Dynex since its formation in 1955. He was with Vickers, Inc., for the previous fifteen years.

*Hare*

*Stone*

### Lt. Gen. Stone to head Hydraulics Group

Lt. Gen. Charles B. Stone, III, USAF (Ret.), has been made a vice president of American Brake Shoe Co., New York, and group executive of its new Hydraulics Group. He will be responsible for the operations of the group—Denison Engineering Div., Kellogg Div., Raymond Atchley, Inc., and Hydel, Inc. Group headquarters will be established in Los Angeles. Stone retired as commander of the Continental Air Command. He was senior member of the U. S. Delegation to the United Nations Military Staff Committee. During World War II, he was chief of staff of the Eastern Air Command, and commanding general of the Fourteenth Air Force.

### Esberg to manage Greer

Alfred M. Esberg has been elected to the board, appointed chairman of the executive committee, and appointed general manager of Greer Hydraulics, Inc., Los Angeles and New York. He was founder and president of Eston Chemicals, Inc., Los Angeles, and vice president and director of American Potash & Chemical Corp., Los Angeles. He is a director of the Dutron Corp., San Rafael.

### Parker-Hannifin promotes four

Parker-Hannifin Corp., Cleveland, has named Willard E. Anderson to the new position of regional manager for the eastern central area. He will supervise the direct sales engineers and the district managers of distributor sales in Ohio, Indiana, Kentucky, West Virginia, and western Pennsylvania. He was district manager of distributor sales in Wisconsin, Minnesota, and Iowa. A. N. Aiman is now sales manager of Parker Fittings & Hose Div., Cleveland. He was with Parker Seal Co., Culver City, Calif., as district manager in Detroit. Parker

Continued on page 152

**GROUND IS BROKEN** in Englewood, Colorado for a new $250,000 plant for Wilkerson Corp. Floor area will be 20,000 sq. ft.



Circle **143** ➔

WEAR RESISTANT
THOMSON

# 60 Case

**AVOID the HIGH COST and difficulty of fabricating long, hard & straight parts by conventional methods!**

# hardened and ground

## SHAFTS, ROLLS, GUIDE RODS and other long-round parts

## ELIMINATE WEAR and REDUCE COST

*60 Case* is the result of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

*60 Case* material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining. *Write for literature and name of your local representative.*

**For emergency needs call collect**
**MAnhasset 7-1800**

### ADVANTAGES of *60 Case*

- COST REDUCTION
- HARD BEARING SURFACE
- NICK-& DENT-PROOF
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

### TYPICAL *60 Case* PARTS

GUIDE RODS • SHAFTING • ROLLS • TRAVERSE RAILS
PISTON RODS • ARBORS • LEADER PINS • TIE RODS
KING PINS • AXLES • CONTROL RODS • GUIDE POSTS
MANDRELS • BEARING ROLLERS • SPINDLES

**THOMSON INDUSTRIES Inc.**
**Dept. C-4, Manhasset, New York**

PARTS HARDENED to 60 C...
*increase life...reduce cost!*

# POST SCRIPTS OF INDUSTRY

Seal named George Meyer as manager of manufacturing. He is responsible for all the company's manufacturing in Culver City, East Los Angeles, Calif., and Berea and Lexington, Kentucky. He joined Parker Seal in January, 1959. William Swan is now assistant sales manager of Parker Seal. He was a representative in the Dayton area.

### Foreign subsidiary of Racine formed

Racine Hydraulics Co., Ltd., Zug, Switzerland, has been formed as a wholly-owned subsidiary of Racine Hydraulics & Machinery, Inc., Racine, Wisc. The new company will provide the parent firm with fast service to European customers, and technical liaison between Racine Hydraulics and its foreign licensees. Under consideration is a technical staff to serve as a sales force for Racine's American plants and its overseas affiliates. Racine is also considering the establishment of local assembly and manufacturing sources by the subsidiary. Gordon Fuller, who has been in charge of Racine's foreign operations, heads the subsidiary.

### Titeflex promotes Walsh

Titeflex, Inc., Springfield, Mass., elected Richard G. Walsh vice president of engineering. He was director of engineering since March, 1959. Before joining Titeflex, Walsh managed the Engineering Test and Design Engineering Departments of Ford's Aircraft Engine Div., Chicago.

### Garlock names R & D supervisor, plant manager

Jack A. Henderson was made supervisor of the research and development section, engineering department, Garlock, Inc., Palmyra, N. Y. Joseph G. Woppman has taken the new post of manager of the Palmyra plant. He was manager of the industrial engineering department, Manufacturing Div. Borden R. Bond succeeds Woppman.

*Henderson*

*Reinsma*

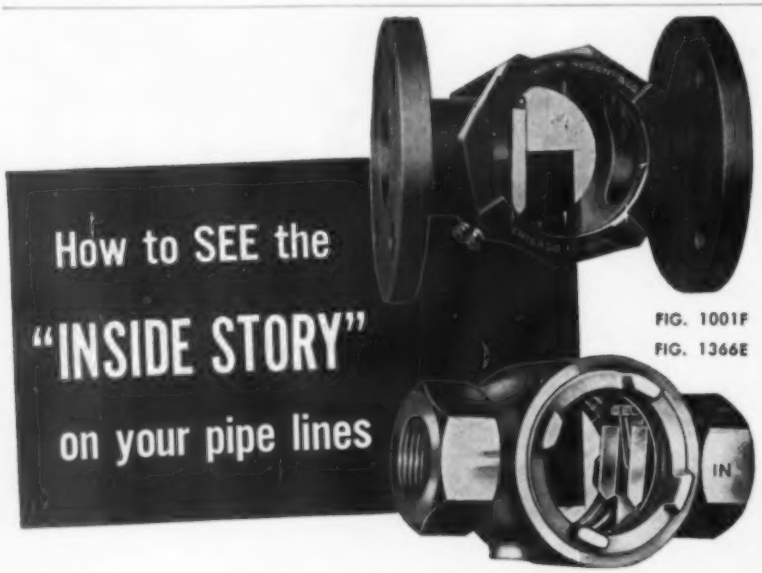
### Reinsma to manage Alemite product programs

Alemite and Industrial Div., Stewart-Warner Corp., Chicago, has appointed Jack Reinsma to the new position of manager of product programs. He will direct development, refinement, and improvement of all the division's product lines. He was sales manager of Alemite industrial lubrication products.

### Anderson discusses distributor's value

Knox, Inc., New England distributor of fluid-power components and systems, recently held a sales seminar at its home office in East Walpole, Mass. President G. W. Anderson said, "The engineering distrib-

Continued on page 154


Do you have pipe lines through which constant flow is a critical factor? Could slowdown or stoppage cause untold damage to valuable equipment? If it's important that you know what's going on inside a pipe line . . . Nugent Sight Flow Fittings can be one of the most economical investments you've ever made.

These fittings have large double windows to aid visibility. A spring compensated, hinged, indicator gate moves in proportion to the flow and is visible from either side, even when liquid is dark or discolored. Fittings available with electrical contacts to operate a bell or light should liquid flow cease. Sizes ⅜" to 6" inclusive . . . in brass, cast iron, and steel. Tapped or flanged.

**Complete data upon request.**

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OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

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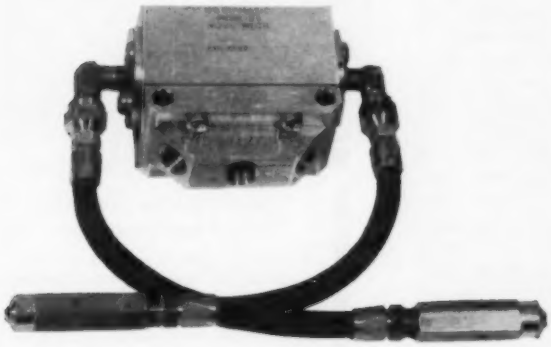
**AUTOMATION SIMPLIFIED**

**with NOVI's proven air-saver valve**

**combining DIRECT AIR, NOVI-MATIC 4-WAY VALVES and NOVI POPPET VALVES**



ORIGINAL EQUIPMENT MANUFACTURERS

Simpler, foolproof air circuits with NOVI valves will cut costs and give better performance.

NOVI VALVES:

- Give positive, instant action
- Have Teflon slides
- Need no lubrication
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- Give guaranteed longer life

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**Novi-Matic Valve Division**
**Novi Tool & Machine Co. Novi, Mich**

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***The following reprints of special reports which have appeared in HYDRAULICS & PNEUMATICS Magazine are available:***

**SO YOU'RE SELECTING AN AIR COMPRESSOR**

Report helps you select the amount of air you'll need, types and number of compressors, drive motors, auxiliary and protective equipment. Application descriptions and photos. Two-page compressor specifications chart. Eleven pages.

**Single copy 50c**
**Over 50 copies, 35c each**

**PLASTIC LINES . . . CAN THEY MEET YOUR FLUID POWER NEEDS?**

Plastic tubing, reinforced plastic hose, and fittings are discussed in this six-page report. Charts and nomographs of burst pressures. Photos show how to install nylon tubing.

**Single copy 25c**
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**WHAT TO LOOK FOR IN AIR VALVES**

This 16-page report contains basic designs of directional control, pressure control and flow control valves. Illustrates many different designs and points to remember in selecting a specific design.

REVISED JIC HYDRAULIC STANDARDS

**Single copy .....75c**
**10 to 24 copies .....60c**
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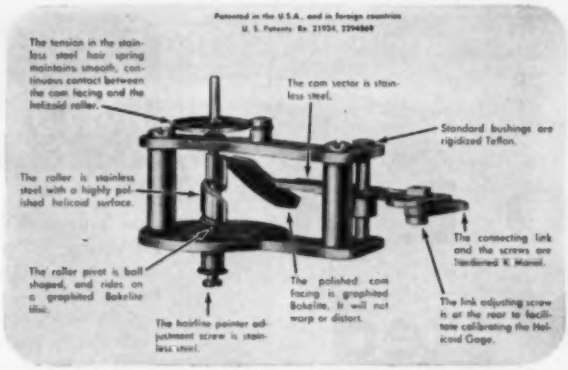
***Send all orders—enclosing the exact amount in coins or checks—to: HYDRAULICS & PNEUMATICS, 812 Huron Road, Cleveland 15, Ohio.***


Patented in the U.S.A., and in foreign countries
U. S. Patents Re. 21934, 2794869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.
Standard bushings are rigidized Teflon.
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The roller pivot is ball shaped, and rides on a graphited Bakelite tilter.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

# Exclusive Helicoid movement provides *Sustained Accuracy* ...on the toughest jobs!

• Helicoid Gages have no gears, no teeth—wear is reduced to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Even when subjected to violent pressure pulsations or mechanical vibrations, Helicoid Gages *stay* accurate. Only Helicoid Gages provide *all* these advantages:

**Sustained accuracy**—Helicoid movements have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy. Conventional *geared* gages on the same test became useless after only 500,000 cycles.

**Durability**—Bourdon tubes won't stretch, leak or crack. Dial faces won't corrode or chip.

**Wide selection**—Gages are available for practically any application from tap water to acid. Gages include flanged and flangeless, round and square, in standard and flush-mounting models. Accessory equipment includes gage cocks, needle valves, siphons and snubbers.

## NEW! Solid-Front Safe-T-Case Gage

This new Helicoid design diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming the back cover plate, which can then be replaced inexpensively.

***Write*** **for Catalog DH-65 for details on the complete line of Helicoid Gages**

Distributed in Canada by Upton, Bradeen & James, Ltd.
Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Edmonton, Vancouver

**HELICOID GAGES** ACCO

**Helicoid Gage Division • American Chain & Cable Company, Inc.**
**929-H Connecticut Ave., Bridgeport 2, Conn.**

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# O. E. M. Voted For

## Permaseal

**HYDRAULIC PISTON RINGS**

**Fluid Power Requirements Demand The Sealing Features Found In PERMASEAL Rings**

*Here are the Reasons For Manufacturers' Preference:*

- Permanently leak-proof after many thousands of hours of use.
- Seals equally in BOTH DIRECTIONS. You need fewer rings per assembly.

- PERMASEAL RINGS are made from the finest grade of gray iron obtainable.
- Perfectly round rings, accurately made and tested.
- Low initial cost and long service life provide unusual economy advantages.
- Large inventory of stock sizes from 1⅜" through 10" O.D.
- Engineering and design service

**grover** piston ring co., inc.

120 N. Broadway, Milwaukee 2, Wisconsin

*"There's Permanency in PERMASEAL"*

WRITE TODAY FOR BULLETIN NUMBER 1260 AND SAMPLE PERMASEAL PISTON RING

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## POST SCRIPTS OF INDUSTRY

utor is a relatively new concept in marketing technical products and gives manufacturers, in effect, a product development group without the overhead and responsibility that might normally be involved. Such a technically oriented distributing company can bring to manufacturers the best know-how available from the companies whose lines it represents and distributes. The broad experience of the engineering distributor avoids 'trial and error' normally involved in the selection of products that apparently have similar functions but entirely different characteristics when they must function as an integrated system."

### Arley Engineering adds Nagel

Arley Engineering Co., Bay City and Flint, has named Lynn L. Nagel as a representative. He will service the Flint, Port Huron, and Owosso districts for Arley. The firm is the northeastern Michigan sales and service representative of Ross Operating Valve Co., Detroit, and several other fluid power manufacturers.

### Armstrong Cork forms new department

Industrial Div., Armstrong Cork Co., Lancaster, Pa., has a new department—Urethane & Fluorocarbon Sales. Ralph M. Hill heads the department, and J. A. Kelly is technical assistant. J. Mason Smith is sales correspondent. The firm recently introduced a fluorocarbon material which can be used for gaskets at temperatures from −425 to 500 F. It has good torque retention, and is completely unaffected by hydraulic fluids.

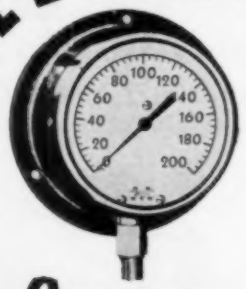
### Owatonna appoints sales managers

Owatonna Tool Co., Owatonna, Minn., appointed John Hann and Robert Wilkinson district sales managers for Oregon, Washington, and Northern California. Wm. M. Myers was assigned Illinois, except Chicago.

Continued on page 156


Circle **95** on Time-Saver Card

**MARSHALLTOWN**



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**The right gauge for your specific needs**

A complete line of gauges in stock available for early delivery. Gauges from 10-inches water pressure to 30,000 P.S.I. to meet your specifications on any equipment.

- Pressure
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- Altitude
- Combination
- Diaphragm
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- Special Purpose
- Dial Thermometer (Vapor Tension or Bi-Metal)

Let Marshalltown answer your gauge problems . . . write for information and prices.

**MARSHALLTOWN MFG. CO.**
MARSHALLTOWN, IOWA

**NOW, SELF-TAPPING MOUNTING SCREWS ENCLOSED IN EACH PACKAGE!**

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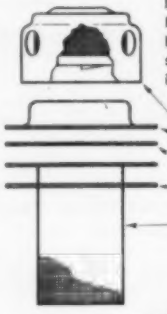
**FILLER-BREATHER**

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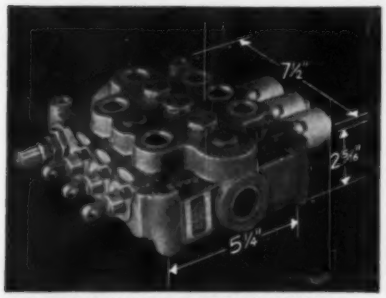


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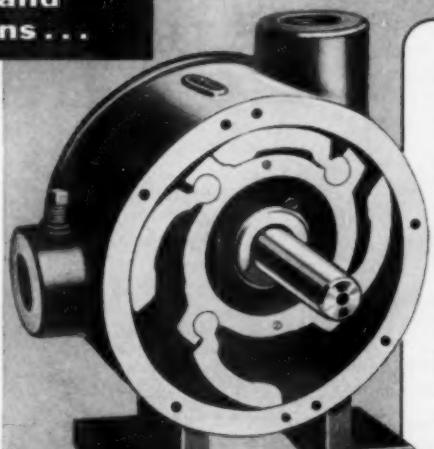

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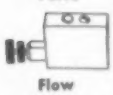
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*R. B. Birge Co.*, Bridgeport, Conn., will stock the complete line of industrial nylon hose made by Synflex Products Div., Samuel Moore & Co., Mantua, Ohio.

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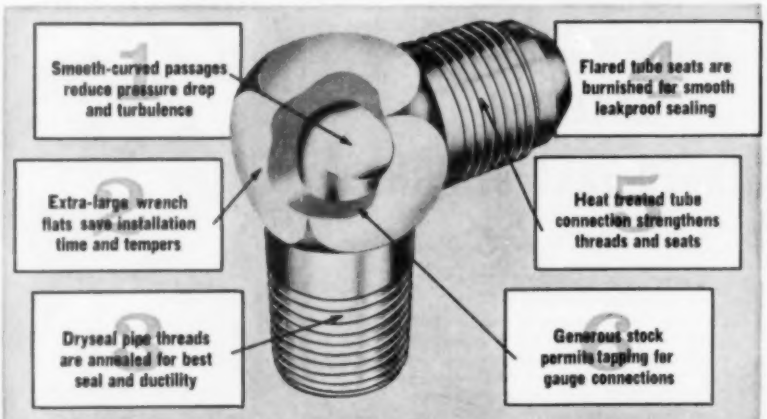
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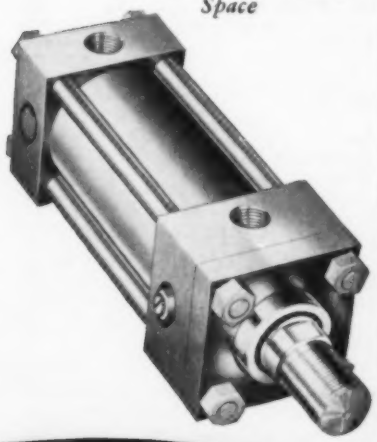

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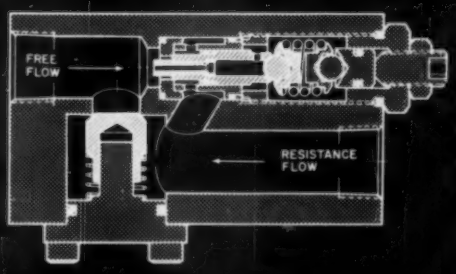


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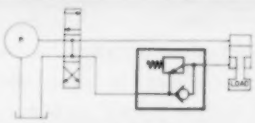

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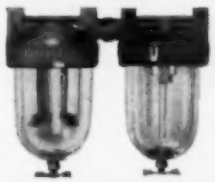

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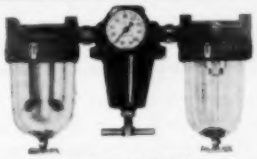

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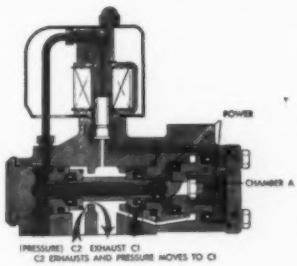


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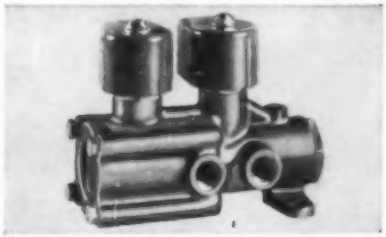

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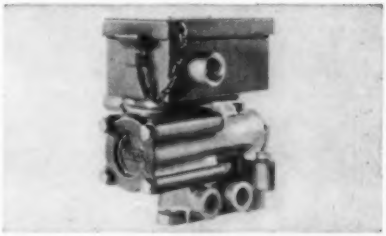

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